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CORRECTIONS

Volume 64, January 1966, Table of Contents, 2d Column, final entry, "Charts I–XII" should be "I–X"; page 7, second column, subhead "CLOUDS": In the second line, third entry, for "2d ed." read "3d ed."; for "1921" read "1964"; page 20: In table 2, column headed "Blue Hill", first line, "88" should be "124"; next line, "173" should be "172"; page 61, after entry "Boston" insert footnote reference number '; in the next three columns "124", "336", and "360" should be "29", "31", and "50", respectively.

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PRESSURE DISTRIBUTION IN RELATION TO THUNDERSTORM OCCURRENCE ON OREGON AND WASHINGTON NATIONAL FORESTS

By ROBERT ALLEN WARD

[Pacific Northwest Forest Experiment Station, July 1935]

INTRODUCTION

Weather forecasting is simplified if a definite relation can be found between local weather and the large-scale picture of meteorological conditions given by a synoptic chart. Investigations of the conformity of various meteorological phenomena to certain types of pressure distribution over large areas have been carried on since the early days of synoptic meteorology. One of the earliest classifications of the various types of pressure distribution which repeatedly appear on any series of weather maps was made by Abercromby (1) for the northeastern Atlantic Ocean and northwestern Europe. Reed (7) has discussed the recurrence of pressure types over the northeastern Pacific Ocean and adjacent land areas.

The thunderstorms of the United States have been classified by Humphreys (5) according to the disposition of the isotherms and isobars on the weather map. The three conditions, any one of which he states may produce the vertical temperature gradient required for the development of rapid convection giving rise to thunderstorms are: (1) Strong surface heating, especially in regions of light winds; (2) the overrunning of one layer of air by another at a temperature sufficiently lower to induce convection; (3) the underrunning and consequent uplift of a saturated layer of air by a denser layer.

Alexander (2), in 1927, made a study of the relation between thunderstorm occurrence in the State of Washington and types of pressure distribution over the Pacific Coast States. The four types of pressure configuration which he identified bore a definite relation to those outlined by Humphreys (5).

Stevens (8) has developed a series of correlations between 8 a. m. eastern standard time barometric pressures, vapor pressure, 24-hour barometric pressure change at selected stations, and the extent of thunderstorms in western and central Oregon. Pressure differences between various stations were used as an indication of a north-south trough of low pressure, or the presence of a cyclonic disturbance to the north of the region. Vapor pressure was used to indicate whether moisture conditions are favorable for thunderstorm inception. These correlations were intended only as a supplement to knowledge of the general pressure distribution conducive to thunderstorm development, and other factors such as free air conditions.

Morris (6) has focused attention on the frequency and behavior of thunderstorms and number of forest fires caused by them in the mountainous areas of Oregon and Washington. It was shown that thunderstorms constitute the greatest single cause of forest fires on the national forests of that region. Since 1924 exhaustive reports of thunderstorms from Forest Service lookouts have been collected and plotted, with the result that there is now available an immense volume of data on their frequency, tracks, hours of occurrence, etc. These have been summarized (6) for the period from 1925 to 1931.

The forecasting of these destructive agents is a problem of major importance in this region during the dry summer season. A familiarity with any correlation between thunderstorm occurrence and the general pressure distribution shown on the synoptic chart is certain to be a valuable aid in the prediction of such phenomena. Gray (4), in a study of California thunderstorms, has stated that "* * * isobaric charts must remain of paramount importance * * * to the forecaster."

The purpose of the present report is (1) to relate the basic information furnished in Morris' report definitely to forecasting problems, and (2) to carry on the analysis begun by Alexander, enlarging its scope to include the State of Oregon and making such revisions and additions as seem necessary in the light of the increased information available in recent years.

PRESSURE TYPES

In examining the a. m. and p. m. synoptic charts for the 10-year period 1925 to 1934, four distinct types of pressure distribution were identified as giving rise to thunderstorms on the national forests of the Pacific Northwest. These are definitely related to the types described by Humphreys and Alexander. Listed according to their frequency and forecasting importance they are: Type I. Trough; Type II. Cyclonic; Type III. Transition; Type IV. Border.

CHARACTERISTICS OF THE PRESSURE TYPES

Type I. Trough thunderstorms.—This type corresponds to Humphreys' (5) "low-pressure trough between adjacent high-pressure areas", and at times to his "regions of high temperatures and widely extended, nearly uniform pressure." It is similar to Alexander's (2) "anticyclonic or trough storm." Low pressure overlies the interior portions of Oregon and Washington between areas of high pressure over the northeast Pacific Ocean and the Rocky Mountain region or the Great Plains. It is the "Northerly Type" of pressure distribution described by Reed (7) as typical of the northeastern Pacific in summer. Frequently it is almost the same pressure condition identified by Abercromby (1) as a Col—a region of relatively low

pressure between adjacent areas of high pressure, a region of light, variable winds and unsettled weather especially productive of thunderstorms.

During the prevalence of a type I pressure distribution a number of the requirements outlined by Brooks (3) as necessary for the development of local, convectional thunderstorms are admirably fulfilled. There are, for example, large volumes of warm air available because of light, variable surface winds; and a lack of a marked diversity in the air movement aloft, due to a general stagnation of conditions. Table 1 illustrates the extremely light winds observed at high levels over the Pacific Northwest on a day of thunderstorms during type I pressure conditions. Violent convection results because these conditions are ideal for the air at the surface to become hot relative to that aloft. Other factors influencing local convection, present as a rule during type I conditions, are clear mornings, permitting rapid surface heating, a dry condition of the ground, and a supply of cold air at high levels. The cold air aloft is due partly to clear, calm nights favoring rapid radiation, and partly to the presence of a current of Polar Pacific air, or transitional Polar Pacific air [1] over most of the Pacific Northwest at high altitudes in the summer (9).

The "trough" type was found to possess three distinct variations, basically similar, but differing in details, particularly as to the location of the trough. Accordingly, the type was subdivided as follows:

Type Ia.—In this variation of the type the center of the trough lies over the Cascade Range or just west of it (fig. 1). It is a northward extension of the semipermanent Colorado Valley "heat" LOW, and usually sets in over southwestern Oregon, extending slowly northward west of the Cascades over a period of several days. Under these conditions abnormally high temperatures are ordinarily reported from the interior portions of Oregon and Washington which lie west of the Cascade Range. In the 10-year period, 1925 to 1934, no "general" and few "intermediate" storm days were caused by type Ia in the State of Washington, but it was an important cause of "intermediate" storm days in western and central Oregon. The thunderstorms developed seem to be the result of local convection. They usually develop shortly after a very dry mass of air moving from the north or northeast at high levels is replaced, or beginning to be replaced, by air of oceanic origin. In other words, the influence of the continental high-pressure area, with its dry transitional Polar Pacific air, is weakening, while a new mass of relatively moist and cool air is moving in at high levels. A shift of wind above 6,000 feet from northeast or east to southeast and south at Medford is an indication of the beginning of a type Ia condition. Within 36 hours southeast to southwest winds reach northward at high levels to Portland and Seattle, although northwest to northeast winds may continue at the surface. Since this type characteristically sets in at the breaking up of a period of east-wind conditions over the Pacific Northwest, the thunderstorms which it causes are likely to result in large fire losses because the forests in such cases have been thoroughly reduced to tinder dryness by winds of very low relative humidity blowing from the interior for several

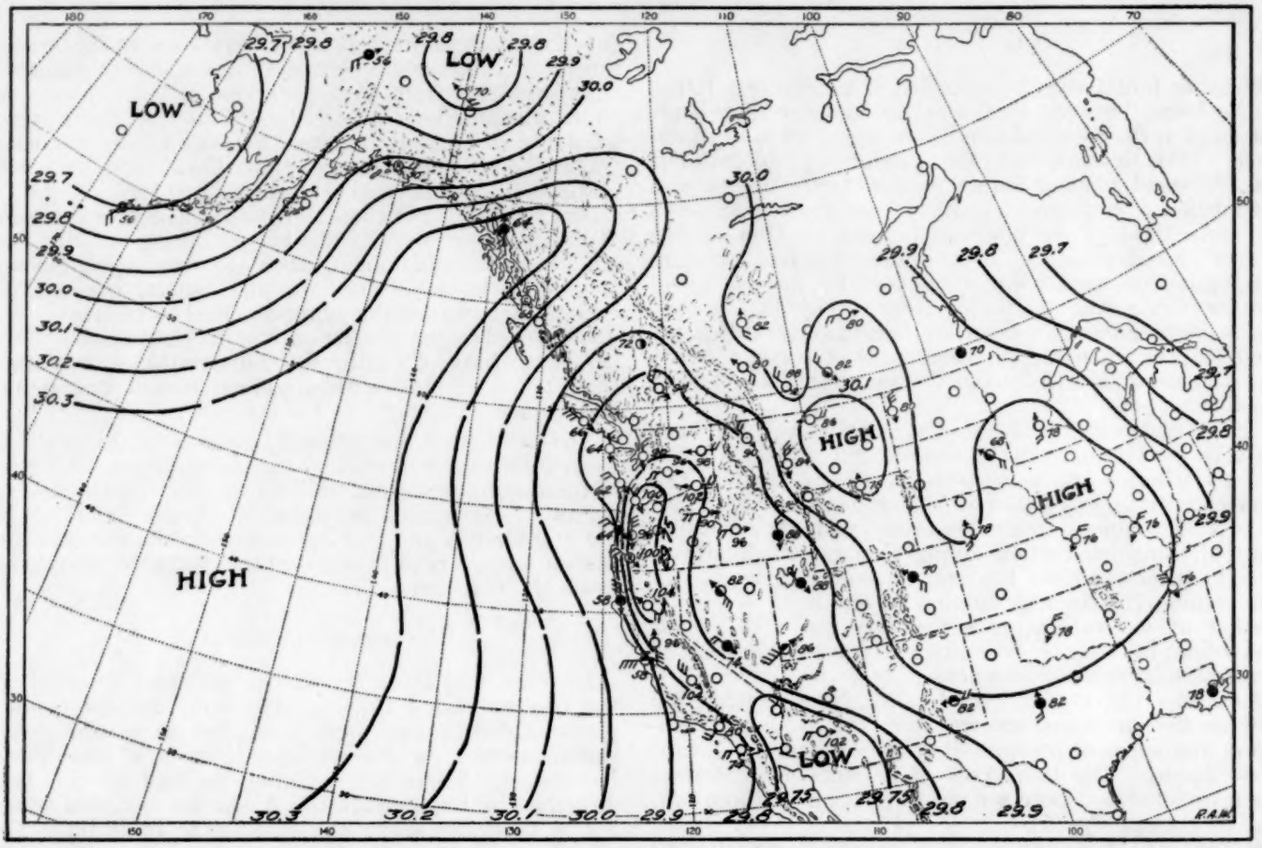

FIGURE 1.—July 23, 1927, 5 p. m. (One hundred and twentieth meridian): Conditions favorable for the development of "trough" thunderstorms of type Ia in Oregon and Washington.

[1] The air mass terminology employed by Willett (9) is followed in this report.

days. As thunderstorms of type Ia are usually not accompanied by large amounts of precipitation, each "strike" may cause a fire which will spread rapidly in the dried-out forest. The type generally breaks up with an influx of high pressure from the Pacific. In this case it passes through the transition stage of type III (see below) before being supplanted by high pressure. On the other hand, the trough may be pushed only slightly eastward, in which case a type Ib condition is the result. This may cause a continuation of thunderstorms for an indefinite period. The weather maps of June 10 to 14, inclusive, 1932, illustrate the development of type Ia conditions following a period of interior winds. Those of July 22 to 25, inclusive, 1927, illustrate the type as associated with record-breaking high temperatures at many stations west of the Cascades in Oregon.

Type Ib.—This subdivision is similar to type Ia, but the center of the trough, while west of the one hundred and fifteenth meridian, lies definitely east of the Cascade Range (fig. 2). Temperatures in this case are generally seasonable west of the Cascades and high east of them, and the thermal, as well as the pressure, gradient between North Head and Portland on the p. m. chart is considerably less than in the case of type Ia. It is the typical summer type of pressure distribution and is frequently remarkable for its persistence. Occasionally it endures for 2 weeks without important change, during which time thunderstorms are an almost daily occurrence over a considerable area. Winds aloft at Portland and Medford are usually from south to west above 5,000 feet, while at Seattle they are northwest or west. During periods of pronounced thunderstorm activity, however, winds aloft west of the Cascades are south to southwest at all stations. A typical day is illustrated in table 1. Type Ib may develop directly, but it frequently follows or develops out of a type Ia distribution by a mere shifting of the axis of the trough to the eastward of the Cascades. This change brings to an end the hot weather west of the mountains, but by no means an end of thunderstorm conditions there. The type apparently will not definitely break up until a large-scale movement inland of fresh Polar Pacific air takes place, produced either by the appearance of a cyclonic depression at the northern end of the trough which moves eastward, or by a definite inland movement of a portion of the Pacific HIGH. In the latter case the transitional type III stage occurs for a day or two before the definite end of thunderstorms. The weather maps from July 30 to August 3, inclusive, 1927, illustrate a protracted period of type Ib pressure distribution which was productive of unusually large fire losses. Those from July 29 to August 3, inclusive, 1929, are illustrative of another period of great thunderstorm activity. Like those of type Ia, thunderstorms of type Ib are generally of the "dry" type.

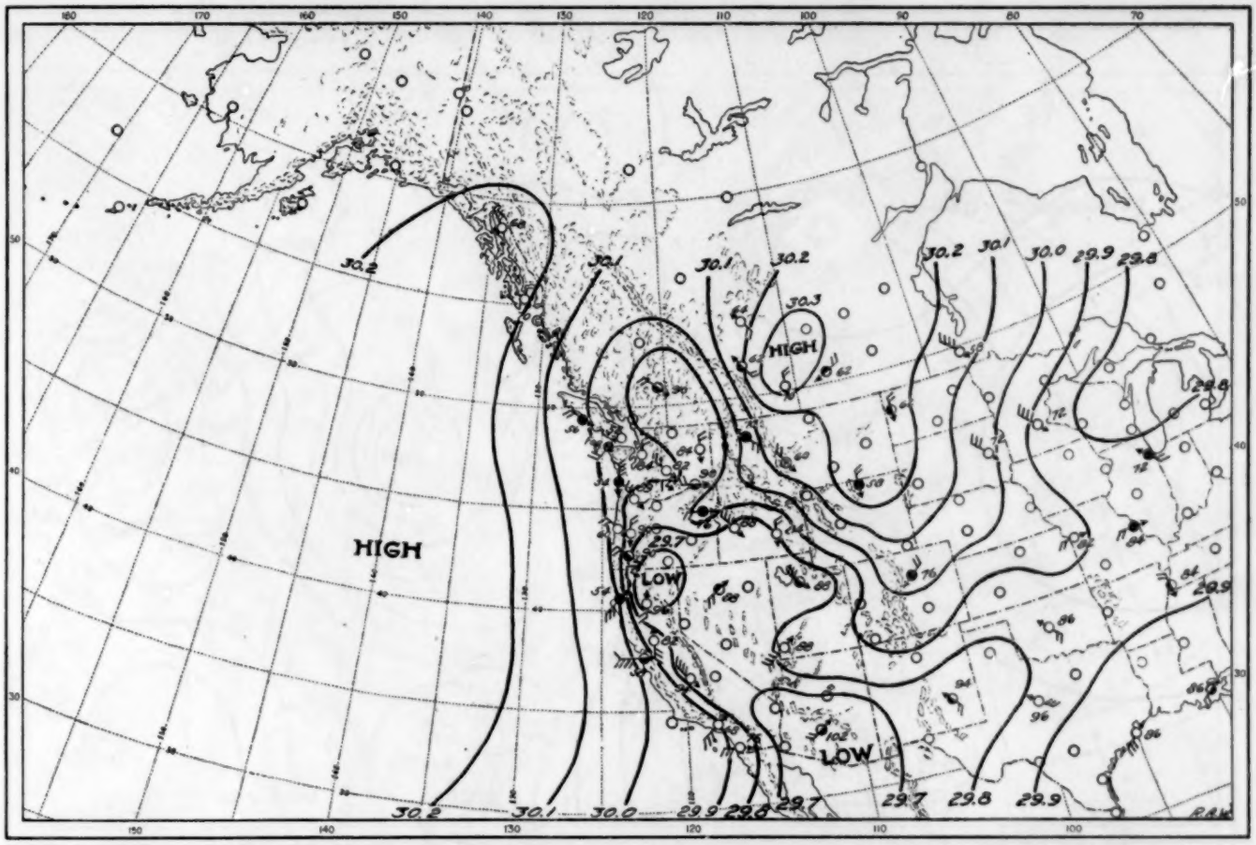

FIGURE 2.—July 31, 1927, 5 p. m. (one hundred and twentieth meridian): Conditions favorable for the development of "trough" thunderstorms of type Ib in Oregon and Washington.

TABLE 1.—*Free air wind directions and velocities*[1] *on a type Ib day—July 29, 1931, 3.30 a. m.*

Altitude	Seattle	Portland	Medford	Pasco	Spokane
Surface	SE, 1	S, 13	WNW, 6	NNW, 10	X.
2,000 feet	NW, 10	W, 3	WNW, 6	N, 13	N, 1.
4,000 feet	NNW, 11	NW, 11	SW, 4	N, 17	ENE, 16.
6,000 feet	SSE, 6	WNW, 8	N, 2	N, 16	E, 5.
8,000 feet	SSW, 4	ESE, 2	SSW, 15	ESE, 7	X.
10,000 feet	SSW, 6	ESE, 4	SSW, 16	X	X.
12,000 feet	X	SE, 2	SSW, 18	X	X.

[1] Wind velocities in miles per hour.

Type Ic.—This subdivision is almost identical with Abercromby's (1) definition of a Col. Pressure over Oregon and Washington is relatively low while pronounced areas of high pressure overlie the northeast Pacific Ocean and the Rocky Mountain-Great Plains region. Ordinarily the area of low pressure is ill-defined and not definitely related to the lower Colorado River Valley LOW (fig. 3). It may, however, eventually become so. On other occasions the Col is associated with the northwest quadrant of an area of low pressure in the process of development over the Plateau region. A stagnant condition of the lower levels of the air, with light, variable winds over the Pacific Northwest, is characteristic of type Ic and this condition may extend upward to a considerable height.

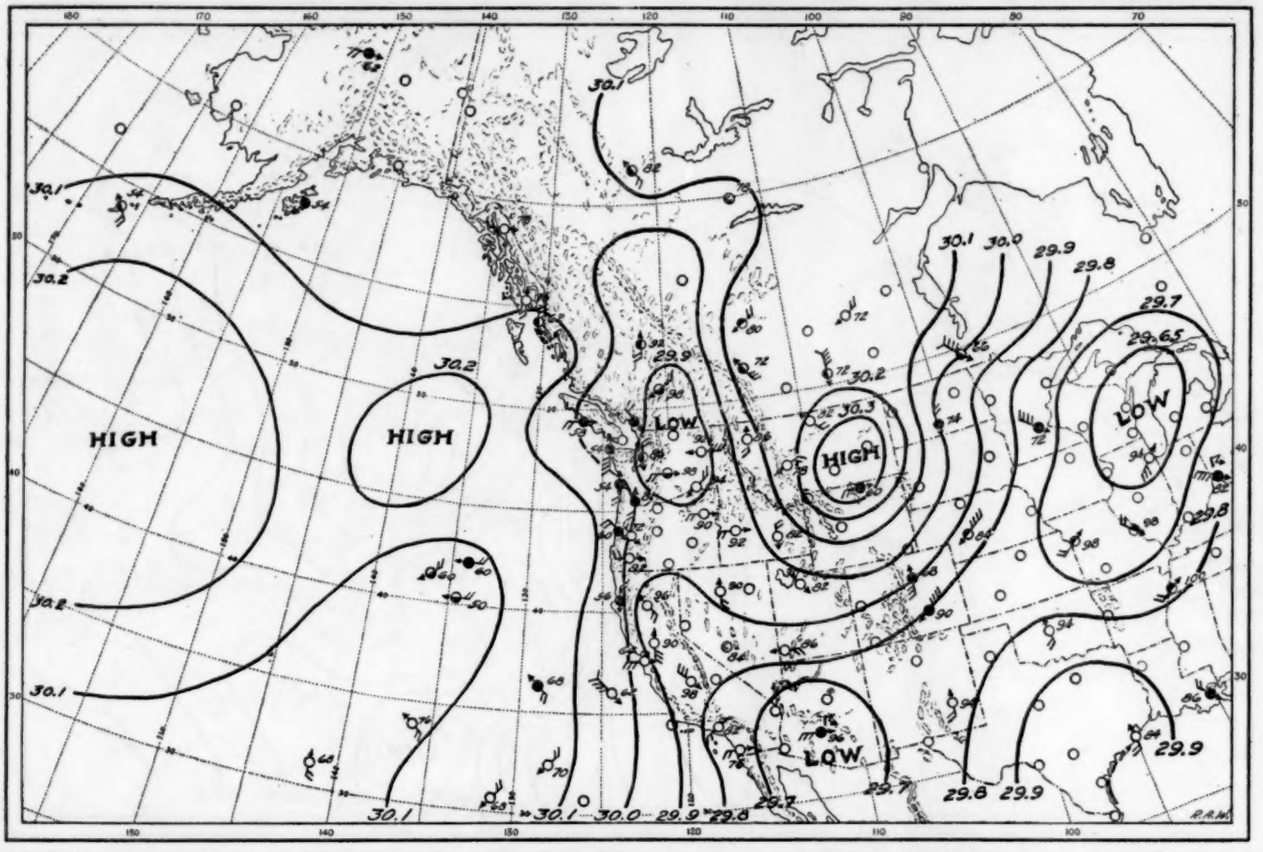

FIGURE 3.—July 12, 1930, 5 p. m. (one hundred and twentieth meridian): Conditions favorable for the development of "trough" thunderstorms of type Ic in Oregon and Washington.

At high levels the winds are moderate to fresh southeast to south at Medford, south to southwest at Portland and Seattle. The type may break up by the Col favoring a northward extension of the Arizona LOW, in which case it merges into type Ib, or by the eastward movement or dissipation of the Great Basin LOW with rising barometers over Oregon and Washington. The weather maps of July 11 to 14, inclusive, 1930, illustrate the Col variation of type Ic. Those of June 1 to 4, inclusive, 1933, illustrate it in connection with the development of a Great Basin depression.

Type II. Cyclonic thunderstorms.—This type corresponds to Alexander's (2) and Humphreys' (5) types of the same name—"the southeast, or, less frequently, the southwest quadrant of a regularly formed LOW or typical cyclonic storm." The cause of thunderstorms in the southeast quadrant of a depression is a rapid decrease in temperature with altitude resulting from the different points of origin of the lower and upper air masses (5). As Alexander points out, however, in the Pacific Northwest, thunderstorms are more frequent in the southwest quadrant of a LOW. Most of the cyclonic disturbances of the summer season develop inland from the Gulf of Alaska at high latitudes, pursuing a course thence south-southeastward to southern Alberta, whence they move eastward. At times they originate as secondaries over southern British Columbia or Alberta, the parent depression remaining far to the north. In either event, the Pacific Northwest is never within the southeast quadrant of such a LOW. Nevertheless, cold air is drawn in aloft, overrunning the warm air which overlies the surface; and convection is generally sufficient to produce thunderstorms in Oregon and Washington in the southwest quadrant of the depression. Type II was divided into two subdivisions, as follows:

Type IIa. The southeast quadrant of a regularly formed LOW *or typical cyclonic storm.*—In the period under consideration the occurrence of this type was confined to the late spring and early fall. The usual situation is a LOW of considerable extent and energy central a few hundred miles west of the Oregon-Washington coast, moving slowly north-northeastward (fig. 4). Small secondary offshoots pass rapidly inland over the Pacific Northwest, chiefly evident as distortions in the isobars. During this process thunderstorms develop locally in Oregon and Washington. Since they are usually accompanied by considerable precipitation and occur in conjunction with fairly general showers they are not of great importance so far as fire risk is concerned. After a day or two the parent depression begins to fill up rapidly, coincident with an increase

in intensity of a redevelopment east of the Cascades. Soon after the disintegration of the ocean LOW sets in, thunderstorm activity ceases. Winds aloft are south to west at all stations, identical with the upper air winds during periods of cyclonic development in the winter months. An occasional LOW off the Queen Charlotte Islands will produce thunderstorms in Oregon and Washington during the fire-weather season, but such occurrences are very rare. Weather maps of June 13 to 16 inclusive, 1931, and of April 30 to May 2, inclusive, 1932, are admirably illustrative of type IIa.

Type IIb. The southwest quadrant of a regularly formed LOW *or typical cyclonic storm.*—LOWS which develop as offshoots of low-pressure conditions in the Gulf of Alaska during the summer months pass southeastward or south-southeastward over the Canadian Northwest Territories to Alberta, moving thence eastward across the Prairie Provinces. While they are centered over southern Alberta, or, less frequently, over the interior of southern British Columbia at the northern end of a trough extending southward to Mexico, thunderstorms develop over Oregon and Washington (fig. 5). In any examination of maps, however, care must be exercised to distinguish a true cyclonic development from the ordinary area of relatively low pressure which seems to exist at Kamloops so frequently during the prevalence of type Ib. This is, like the entire trough, largely a thermal phenomenon. The true cyclonic development in that area extends farther eastward and southeastward, is usually accompanied by a more characteristically cyclonic wind circulation with increased velocities, and generally passes eastward after a day or two with rising pressure in its rear. Upper-air winds at Medford and Spokane furnish a clue to the character of the LOW. Winds above the 8,000-foot level are always fresh to strong south or southwest at these stations during a definite cyclonic period. The type breaks up when a definite eastward movement of the LOW occurs, usually indicated by a shift of wind towards northerly points at high levels above Portland and Seattle. Illustrations are furnished by the weather maps of September 5 to 7, inclusive, 1931, and from July 6 to 10, inclusive, 1933. The latter example, in particular, shows that cessation of thunderstorm activity does not occur so long as pressure remains low over eastern Washington, but does occur immediately after a pronounced eastward movement of the Alberta LOW.

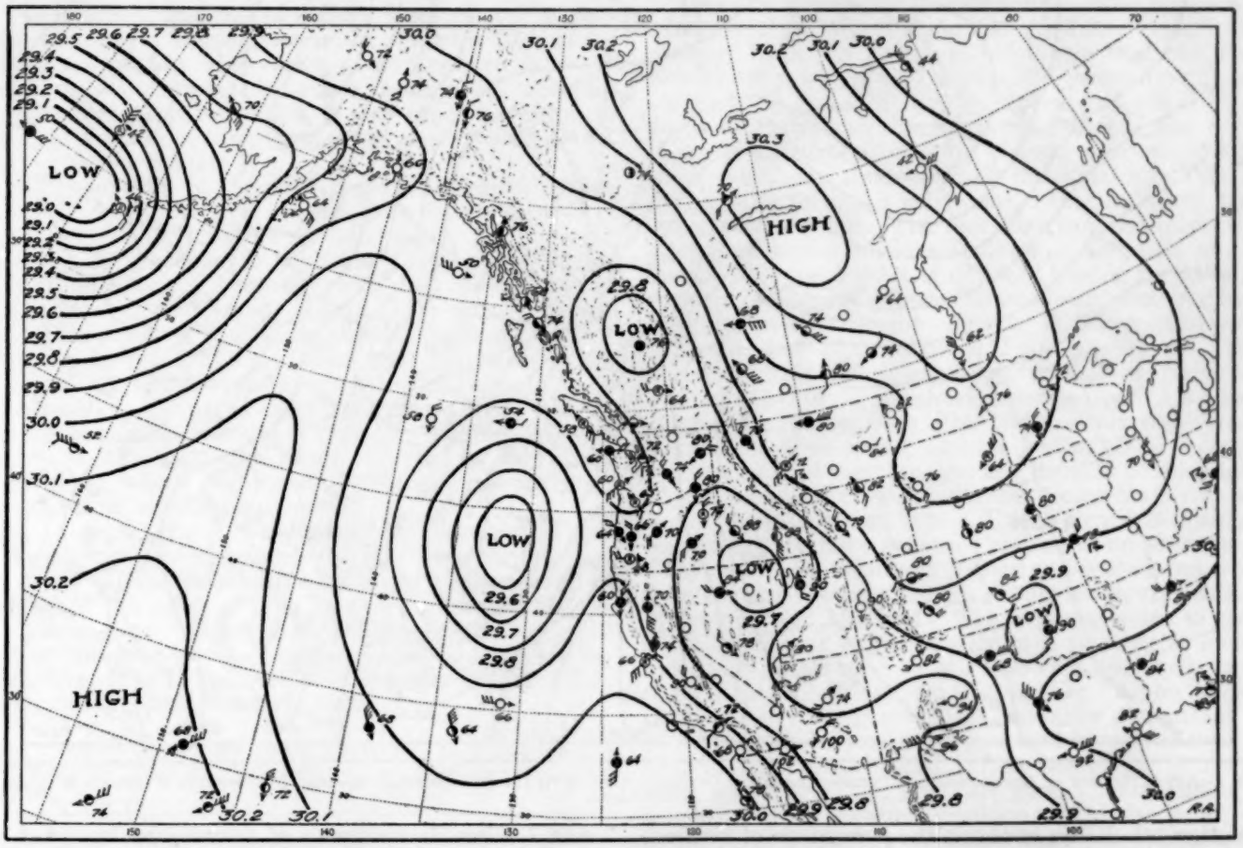

FIGURE 4.—June 14, 1931, 5 p. m. (one hundred and twentieth meridian): Conditions favorable for the development of "cyclonic" thunderstorms of type IIa in Oregon and Washington.

PERCENTAGE OF THE PRESSURE-TYPE DAYS WHICH CAUSED THUNDERSTORMS

During the 10-year period there were certain occasions when one of the four pressure types occurred without thunderstorms being reported. To determine the percentage of occurrences of the pressure types which were not attended by thunderstorms, all occurrences of the types for the months of June, July, and August were tabulated for the 10 years. May and September were not used in this analysis because many of the lookout stations are not manned until the middle of June, nor after the middle of September, and reports of thunderstorms are incomplete. Of all the days on which one of

the four characteristic pressure types prevailed, only 15 percent had no thunderstorms reported. The annual percentage of thunderstorm verification ranged from 76 percent in 1929 to 95 percent in 1934. Since a considerable number of the unverified types were early in June, and since a great many of the remainder were days at the beginnings of more or less extended periods of the types attended by thunderstorm activity on the ensuing days, it is probable that the actual percentage of thunderstorm occurrence following a given pressure type is considerably higher than the 85 percent found in this tabulation. In fact it appears that, in general, thunderstorms result from the pressure types at least 90 percent of the time.

the southeast quadrant of a cyclone, while most frequent in May and September, never occurred in July or August. In contrast, type IIb thunderstorms, the southwest quadrant of a cyclone, were most frequent in July and least frequent in September. Type III thunderstorms, the transition type, were also most frequent in July and least frequent in May and September. Type I (considered as a unit) accounted for 67 percent of the total number of storm days, the remainder being equally divided between types II and III. Of the total of 625 days with thunderstorms reported during the 10-year period, 254, or 41 percent, were produced by a type Ib pressure condition.

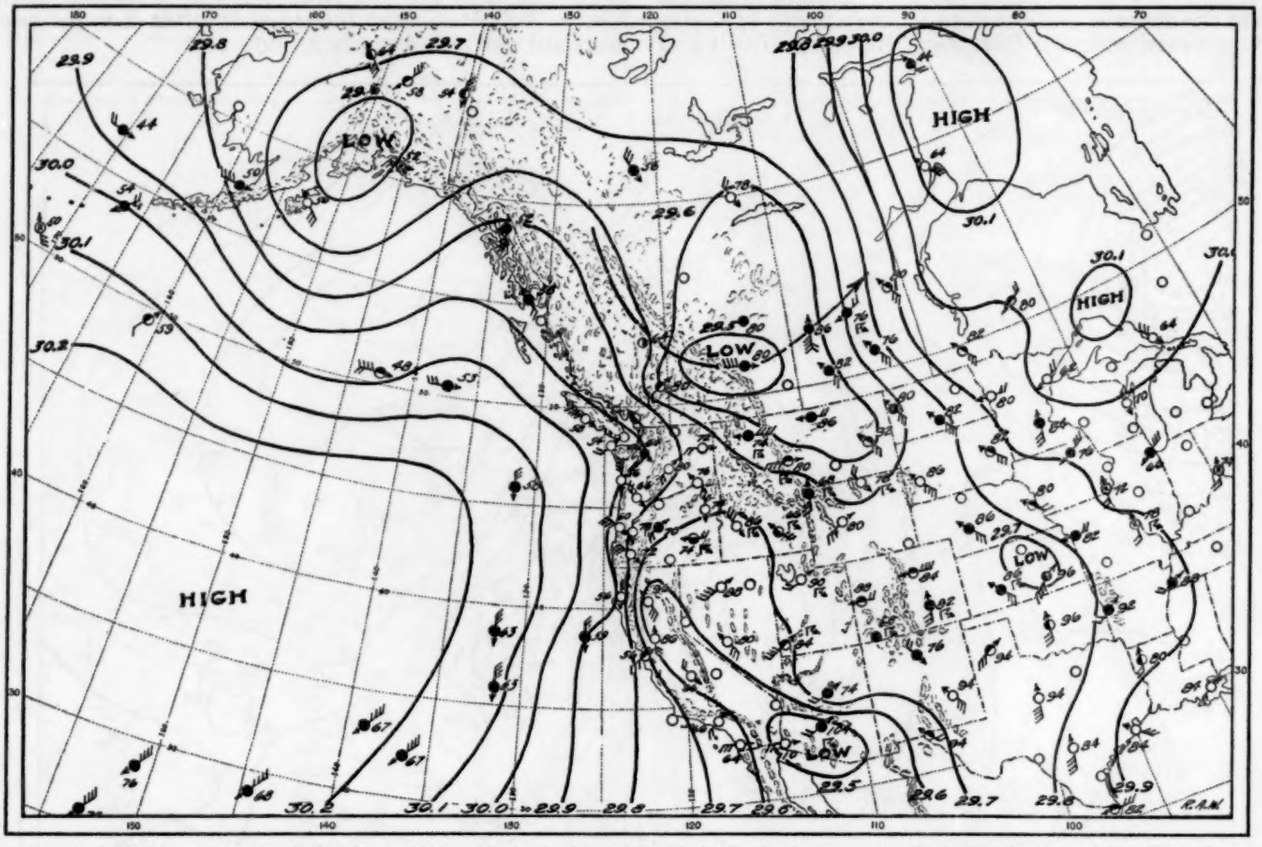

FIGURE 5.—July 8, 1933, 5 p. m. (one hundred and twentieth meridian): Conditions favorable for the development of "cyclonic" thunderstorms of type IIb in Oregon and Washington.

Another tabulation to obtain the percentage of verification for each pressure type separately showed that 91 percent of the days with a type Ic distribution were attended by thunderstorms, 90 percent of type III, 86 percent of type Ib, 82 percent of type IIb, 77 percent of type Ia, and 40 percent of type IIa.

FREQUENCY OF TYPES

The total number of thunderstorm dates due to each type of pressure distribution was tabulated by months from May to September for the 10-year period 1925–34 to discover the month of greatest frequency for each type (table 2). August is the month of greatest thunderstorm occurrence with July only slightly behind. Type I thunderstorms (trough) were most frequent in August and least frequent in May. Type IIa thunderstorms,

TABLE 2.—*Monthly distribution of pressure-type days which produced thunderstorms in either Washington or Oregon, 1925 to 1934*

Month	Type I (trough)			Type II (cyclonic)		Type III (transition)	Type IV (border)	Total	Percent
	a (West of Cascades)	b (East of Cascades)	c Col	a (Southeast quadrant)	b (Southwest quadrant)				
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	
May	4	15	11	9	14	13	0	66	11
June	15	36	26	2	18	24	0	121	19
July	14	79	21	0	22	33	0	169	27
August	19	96	21	0	18	18	0	172	27
September	14	28	18	12	9	14	2	97	8
Total	66	254	97	23	81	102	2	615	100
Percent	11	41	15	4	12	16	1	100	------

RELATION OF PRESSURE TYPES TO THE EXTENT OF THE THUNDERSTORMS

In considering the thunderstorm days so far, no attempt has been made to distinguish between days with very few storms and days with widespread storm occurrence. Morris (6) has shown that the so-called "general"[2] storm leads all others as a cause of forest fires. Storms of this class, although of relatively infrequent occurrence, may account for as high as 92 percent of the total number of lightning-caused forest fires in a single year. For the period from 1925 to 1931, inclusive, covered in Morris' report, "general" thunderstorms accounted for 66 percent of all forest fires started, "intermediate" storms 24 percent, and "local" storms only 10 percent. For this reason, the relation of each pressure type to the extent of the resulting thunderstorms is important.

The inherent tendency of a given pressure type to produce widespread thunderstorms, or the odds in favor of widespread storms whenever a given pressure type appears, may be expressed by the number of "general" thunderstorm days developed by the type in relation to the total number of thunderstorm days developed by the type as shown in table 3.

The proportion of the widespread thunderstorms due to a given pressure type indicates the forest-fire risk of that type. This measure includes both the inherent tendency of the type to produce widespread thunderstorms and the type frequency. Table 4 shows that the trough east of the Cascade Range alone caused 58 percent of the "general" storms in the Pacific Northwest.

In the 10-year period 4 days were noted on which "general" thunderstorms occurred in all 3 subregions on the same day. Three of these were the result of type Ib pressure conditions and one of type Ic. During the same period, 2 days, both the result of type Ib conditions, occurred on which "intermediate" thunderstorms were reported from all three subregions.

On 17 days "general" thunderstorms occurred in two of the subregions simultaneously. Of these days, 9 were the result of type Ib pressure conditions, 4 the result of type IIb, 3 the result of type Ic, and 1 the result of type Ia. On 24 days "intermediate" thunderstorms occurred in 2 of the subregions simultaneously—14 of these resulted from type Ib pressure conditions, 5 from type IIb, 3 from type III, and 2 from type Ia.

TABLE 3.—*Percentage of the storms produced by each pressure type which became "general", "intermediate", or "local" in extent, 1925 to 1934*

Date	Type I (trough)			Type II (cyclonic)		Type III (transition)	Type IV (border)
	a West of Cascades	b East of Cascades	c Col	a (Southeast quadrant)	b (Southwest quadrant)		
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
"General" thunderstorms	5	14	12	0	13	2	0
"Intermediate" thunderstorms	30	24	14	8	24	12	0
"Local" thunderstorms	65	62	74	92	63	86	100
Basis: Total number of thunderstorm occurrences for all subregions	107	437	154	48	150	138	3

[2] A "general" storm, according to his definition, is one in which many small storms affect two-thirds or more of the area of any subregion, or in which one or more storms make a continuous track at least two-thirds the length of the subregion (the three subregions were: Western and central Oregon, the Blue Mountains of northeastern Oregon, and the Cascade Range and northeastern part of Washington).
A "local" storm is one in which there is only one or a few individual storms affecting a small area in any subregion.
An "intermediate" storm in any subregion is one in which the individual storms are more widespread than for a "local" but less extensive than for a "general" storm.

TABLE 4.—*Percentage of the "general" thunderstorms in each subregion produced by each pressure type, 1925 to 1934*

Subregion	Type I (trough)			Type II (cyclonic)		Type III (transition)	Type IV (border)	Number of cases
	a West of Cascades	b East of Cascades	c Col	a (Southeast quadrant)	b (Southwest quadrant)			
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Washington	0	74	8	0	18	0	0	23
Western and central Oregon	8	54	19	0	14	5	0	37
Blue Mountains	4	52	21	0	21	2	0	48
All subregions combined	4	58	18	0	18	2	0	108

Type III. Transition thunderstorms.—This type is somewhat akin to Alexander's "combination type." High pressure from the Pacific is bulging in over the Pacific Northwest where winds have quite generally shifted to northerly points, and is displacing low pressure of type Ib or type IIb which formerly covered that region (fig. 6). It thus represents a break-up of some previous condition which has been productive of thunderstorms. It generally exists for but a single day, being definitely transitional in character. The fact that thunderstorms occur when pressure conditions indicate a cessation of them makes this type worthy of notice. During its prevalence one or more "fronts" appear to pass southeastward across Washington and Oregon, moving in the general southeastward flow of transitional Polar Pacific air. While usually of mild character, these "fronts" are sufficiently well marked to cause thunderstorms locally at points along their course, even after low-pressure conditions at the surface have ceased to be a factor. The HIGH need not push inland very far, but any definite pushing inland of the isobars, ordinarily over the Columbia River area, is an indication of this type. Upper air winds during the transition type have generally shifted to northerly points up to great heights above Portland and Seattle, but remain from southerly points, though of only moderate velocities, at Spokane and Medford. The type may come to an end in either of two ways: Usually high pressure is more or less firmly established by the following day, with typical anticyclonic conditions and fair weather. Upon occasion, however, after bulging inland, the HIGH retreats off the coast once again, and a low-pressure trough of type I is immediately reestablished. Weather maps of July 7, 1926, and August 29, 1927, are good illustrations of the transition-type pressure conditions. On the p. m. map of the former date, an obvious "front", as shown by the surface winds, extends south-southwestward between Spokane and Yakima.

Type IV. Border thunderstorms.—This type corresponds to Humphreys' (5) type "e"—"along the boundary between warm and cool waves", and is identical with Alexander's (2) of the same name. While it is not an uncommon type of pressure distribution during the winter months, being a mild form of Reed's "easterly type" (7), it is extremely rare during the fire-weather season. It occurred only once during the 10 years, 1925 to 1934, the same occasion noted by Alexander. For this reason it may be considered an almost negligible factor so far as fire risk is concerned.

An examination of the records was next made to determine whether "general" or "intermediate" thunderstorms were more likely to occur on the first day that a particular type sets in or on succeeding days. The "first day" was considered as the first day that a type was well

defined and definitely established, as shown by the a. m. weather chart. Conditions indicative of its development may have been evident for one or more days previous to that time, with scattered thunderstorms in some areas. It was found that the first or second day of existence was, in general, the most favorable for the development of scattered or extensive storms. Type Ib developed "general" storms most often on the second day, while type IIb developed them most often on the first day. All widespread storms due to type III occurred on the first day.

Another fact brought out by this analysis was that during any protracted and well-defined thunderstorm period, such as that of July 3 to 20, 1930, a forecaster would be justified in predicting at least "intermediate" storms every day until the period shows definite evidence of breaking up. During this 18-day period there were only 4 days that "general" or "intermediate" thunderstorms did not occur in one or more of the subregions. This was found to be true of all other protracted periods, such as that of July 22 to August 11, 1927, and August 17 to 29 of the same year. During such periods type Ib conditions are the dominant factors, occasionally being modified to type Ia or Ic, and, briefly, by the appearance of a cyclonic storm at the northern end of the trough, to type IIb. It might then almost be said to be the rule that when a type I trough condition becomes firmly established during midsummer, dangerous thunderstorm conditions are likely after the first or second day in any of the subregions. They are likely to continue, with varying intensity, until the pressure rises decidedly over the Pacific Northwest and a complete clearing out of the low-pressure trough takes place.

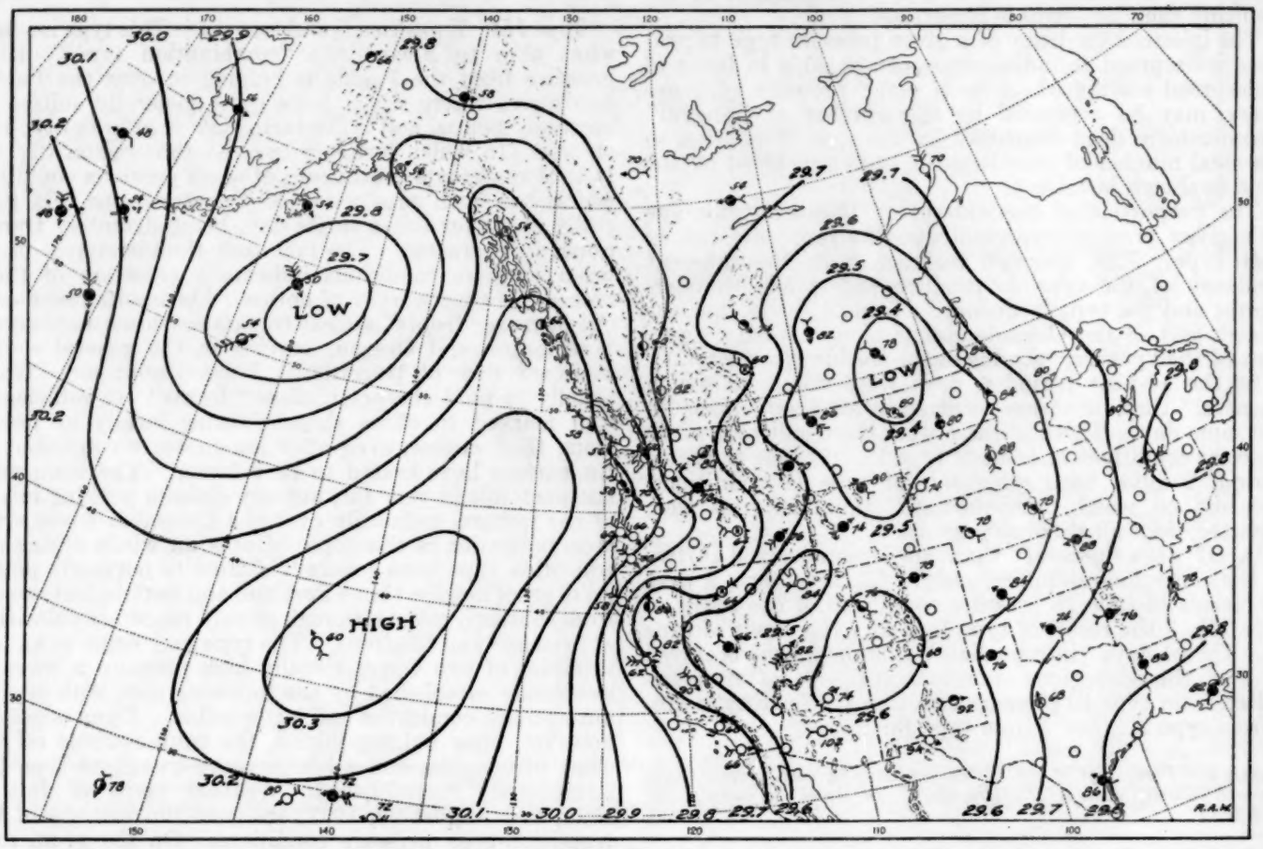

FIGURE 6.—July 27, 1926, 5 p. m. (one hundred and twentieth meridian): Conditions favorable for the development of "transition" thunderstorms of type III in Oregon and Washington.

CONCLUSION

1. Examination of synoptic charts for the 10-year period from 1925 to 1934, inclusive, discloses that days of thunderstorm occurrence can be definitely related to four types of pressure distribution over the Pacific Coast States as follows: Type I. Trough thunderstorms; Type II. Cyclonic thunderstorms; Type III. Transition thunderstorms; Type IV. Border thunderstorms.

In general 85 percent of the pressure-type days produced thunderstorms.

2. Upper-air winds furnish an aid to the identification of the types and indicate the sources of air masses present during thunderstorm conditions.

3. Storms resulting from type I are the most frequent and, because of their tendency to be widespread and to follow dry weather conditions, are the most dangerous. Although storms from the southwest quadrant of a cyclone (type IIa) are as frequently widespread as those from type I, they are usually accompanied by precipitation to a greater extent than those of the other types, and for this reason are somewhat less dangerous. Storms of type III are generally confined to a single day and are most often local in character. Storms of type IV are so infrequent as to be a negligible factor.

4. During the persistence of a trough east of the Cascade Range "intermediate" or "general" thunderstorms are more likely on the second day of the well-marked occurrence of the type than on the first day. For either a trough west of the Cascades or a Col, "intermediate" or

"general" thunderstorms are most liable to occur on either the first or second day. Once having been established, these conditions are likely to continue until a definite replacement of low pressure over the interior of Oregon and Washington by high pressure from the Pacific has taken place.

5. While the types identified in this investigation furnish a practically certain indication of thunderstorms on the national forests of Oregon and Washington, they do not furnish positive indications of whether or not the resulting thunderstorm days will be "intermediate" or "general" in character. It is believed, however, that with the more or less general indications furnished by the type maps and the use of additional aids, such as those furnished in Stevens' report (8), upper air data, dew-point data, etc., an attempt might be made to give somewhat more localized and closely-defined forecasts than have been possible heretofore.

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EFFECT OF INSOLATION ON SOUNDING-BALLOON METEOROGRAPH TEMPERATURE ELEMENTS

By CHARLES M. LENNAHAN

[Weather Bureau, Washington, March 1936]

In view of the increasing interest in stratosphere observations, the recent conclusions reached independently by J. C. Ballard [1] and by L. H. G. Dines [2] regarding the effect of insolation on the temperature element of balloon meteorographs, are worthy of attention.

Dines used 155 soundings which he grouped by months and then subclassified according to day and night, and to ascent and descent. Many of the daytime observations were made near 7h., G. M. T., which corresponds to about 7 a. m., local time in England. The night *descents* were taken as the standard.

Ballard considered about 200 soundings which were grouped according to the three times, 7 a. m., noon, and midnight, C. S. T., for ascents only. The midnight *ascent* was taken as the standard for this study. Ballard's 7 a. m. group corresponds fairly well to Dines daytime ascent group.

Both investigations agree on the following points:

(1) The major part of the insolation effect is a result of the solar rays striking the temperature element, either directly or after one or more reflections inside the ventilating tube.

(2) Diurnal variation and change of air mass are eliminated as possible causes of the discrepancy between daytime and nighttime observations.

(3) The effect of insolation is small in the troposphere compared to its effect in the stratosphere.

(4) 10 kilometers is the critical height above which the error due to insolation becomes excessive.

(5) The poor ventilation resulting from the small density of the air at high altitudes is responsible for the pronounced effect of solar radiation in the stratosphere, and accounts for the fact that the insolation effect increases with height.

(6) The heating of the instrument case, the balloon, and the frame holding the meteorograph are minor sources of error.

The remarkable agreement between the results of the two investigations is shown in the following table of values taken from the published mean error curves:

Dines daytime ascents	Height, kilometer	Ballard 7 a. m. ascents
°C.		°C.
1.0	[1]8	0.5
1.5	[1]10	1.0
2.0	[1]12	2.0
3.0	14	3.0
4.0	16	4.0
5.5	18	5.5
6.0	19	6.0

[1] Dines limited his study to the region between 13 and 19 kilometers, but he extrapolated the curve to lower levels.

Two circumstances are especially significant for this agreement: The first is that the Dines meteorograph was used in England, whereas the Fergusson instrument was used by Ballard. The second is that different methods were used to obtain the results.

The one point of difference in the conclusions from the two studies is in respect to the importance of the angular height of the sun on the effect of solar radiation in the stratosphere. Dines states that the altitude of the sun makes little difference, and that he could find no reason to believe that the recorded temperatures at noon are higher than at other daytime hours; whereas Ballard finds a definite increase in the insolation effect, and consequently an increase in recorded temperature, between the 7 a. m. and the noon ascents.

Both investigations indicate that if the temperature element could be adequately shielded from insolation, the major portion of the error in daytime observations would be eliminated.

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SOLAR OBSERVATIONS

SOLAR RADIATION MEASUREMENTS DURING FEBRUARY, 1936

By IRVING F. HAND, *Assistant in Solar Radiation Investigations*

For a description of instruments employed and their exposures, the reader is referred to the January 1935 REVIEW, page 24.

Table 1 shows that solar radiation intensities averaged close to normal at all three Weather Bureau stations.

TABLE 1.—*Solar radiation intensities during February 1936*

[Gram-calories per minute per square centimeter of normal surface]

WASHINGTON, D. C.

Date	Sun's zenith distance: 8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass: A. M.					P. M.				Local mean solar time
	e	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e
	mm	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm*
Feb. 5	1.60	0.63	0.80	0.96	1.30	------	1.43	1.37	------	------	1.60
Feb. 8	1.02	.81	.88	1.13	1.40	------	------	------	------	------	1.78
Feb. 10	1.32	.67	.75	.99	1.21	------	------	------	------	------	1.19
Feb. 28	2.74	.70	.90	1.11	1.31	------	------	------	------	------	2.49
Feb. 29	3.81	------	------	------	1.05	------	------	------	------	------	3.45
Means	------	.70	.83	1.05	1.25	------	(1.43)	(1.37)	------	------	------
Departures	------	−.03	.00	+.04	+.05	------	+.02	+.37	------	------	------

MADISON, WIS.

Feb. 4	1.24	------	------	------	------	------	1.50	------	------	------	1.07
Feb. 5	.28	.76	.86	1.11	1.36	------	------	------	------	------	.43
Feb. 11	.51	.96	1.11	------	------	------	------	------	------	------	.81
Feb. 14	1.68	------	------	------	1.45	------	------	------	------	------	.74
Feb. 18	1.02	------	1.13	1.28	1.44	------	------	------	------	------	.48
Feb. 19	.51	------	.74	------	1.45	------	------	------	------	------	.64
Feb. 21	.79	------	1.09	1.25	1.43	------	1.42	------	------	------	.86
Feb. 27	1.96	------	------	------	1.37	------	------	------	------	------	1.78
Feb. 29	2.16	------	------	------	1.36	------	------	------	------	------	1.88
Means	------	(0.86)	.99	1.21	1.41	------	(1.46)	------	------	------	------
Departures	------	−.07	−.08	+.01	+.06	------	+.19	------	------	------	------

LINCOLN, NEBR.

Feb. 4	0.43	------	------	1.20	1.53	------	1.57	1.38	1.27	1.14	0.91
Feb. 5	.36	------	------	1.18	1.44	------	------	------	------	------	1.19
Feb. 6	.71	------	------	------	------	------	1.15	.90	.71	.57	.89
Feb. 7	.74	------	------	.84	1.10	------	------	------	------	------	1.08
Feb. 10	.46	------	.94	1.22	1.46	------	------	------	------	------	.74
Feb. 14	.30	------	1.28	1.38	1.53	------	------	------	------	------	.41
Feb. 17	.46	------	------	------	------	------	------	1.30	1.18	1.01	.56
Feb. 20	.81	------	------	.99	------	------	------	------	------	------	1.32
Feb. 26	2.87	------	1.16	1.30	1.48	1.67	------	------	------	------	2.36
Feb. 27	1.37	------	------	1.30	1.36	1.60	1.29	1.14	.94	.77	1.96
Feb. 28	3.45	------	------	.95	1.25	------	------	------	------	------	4.57
Means	------	------	1.13	1.15	1.39	(1.64)	1.34	1.18	1.02	.87	------
Departures	------	------	+.11	−.02	+.02	+.10	−.01	+.02	.00	−.03	------

TABLE 1.—*Solar radiation intensities during February 1936*—Con.

[Gram-calories per minute per square centimeter of normal surface]

BLUE HILL METEOROLOGICAL OBSERVATORY OF HARVARD UNIVERSITY

Date	Sun's zenith distance: 8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7	75.7°	78.7°	Noon
	75th mer. time	Air mass: A. M.					P. M.				Local mean solar time
	e	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e
	mm	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm*
Feb. 1	1.0	------	------	0.63	0.78	------	0.78	0.64	------	------	1.5
Feb. 2	1.2	.96	1.07	1.19	1.45	------	1.45	1.27	1.16	1.07	1.2
Feb. 3	.7	.88	1.02	1.19	1.36	------	------	------	------	------	1.0
Feb. 5	1.9	------	------	------	------	------	1.29	1.24	1.11	.99	1.7
Feb. 6	.7	------	------	1.15	1.26	------	1.32	1.24	1.14	1.04	.9
Feb. 7	1.1	------	------	1.14	1.27	------	1.37	------	------	------	1.1
Feb. 8	.9	.85	.98	1.14	1.27	------	1.37	1.25	1.16	1.07	1.1
Feb. 10	1.1	------	------	.56	.81	------	.84	.76	------	------	1.0
Feb. 11	1.1	------	------	.90	1.09	------	1.21	------	------	------	1.3
Feb. 12	1.3	------	------	1.20	1.40	------	1.42	1.32	------	------	1.0
Feb. 19	.7	------	------	------	1.33	------	1.32	1.21	.98	.80	.8
Feb. 20	1.0	------	------	.92	1.08	------	------	------	------	------	1.3
Feb. 21	1.1	------	.68	.87	1.14	------	1.09	------	------	------	1.3
Feb. 22	1.1	------	------	------	1.26	------	1.33	1.25	1.16	1.07	1.4
Feb. 23	1.0	------	------	1.15	1.40	------	1.45	1.33	1.24	1.16	1.0
Feb. 24	1.9	------	------	1.02	1.33	------	------	------	------	------	2.3
Feb. 28	1.9	------	------	------	1.30	------	1.39	1.23	1.10	1.00	2.0
Feb. 29	1.8	------	------	1.08	1.27	------	1.23	1.07	.98	.92	2.3
Means	------	.90	.94	1.01	1.22	------	1.26	1.15	1.11	1.01	------

LATE DATA

Jan. 4	3.4	1.09	1.15	1.22	1.29	------	------	------	------	------	4.0
Jan. 6	3.2	------	.82	1.03	------	------	------	------	------	------	4.2
Jan. 8	2.5	.87	1.03	1.24	1.33	------	------	------	------	------	2.0
Jan. 10	5.0	------	------	1.15	------	------	------	------	------	------	5.7
Jan. 12	4.0	------	------	------	------	------	1.13	.97	.90	------	3.2
Jan. 14	1.5	.91	1.04	1.18	1.35	------	1.36	1.18	1.03	------	2.1
Jan. 16	3.8	------	------	.79	------	------	1.39	1.29	1.14	.87	2.2
Jan. 17	1.0	.92	1.04	1.18	1.39	------	1.41	1.27	1.15	1.03	1.6
Jan. 20	1.5	------	------	1.04	1.45	------	------	1.27	1.15	1.07	1.5
Jan. 21	1.4	.86	.90	1.07	1.31	------	------	------	------	------	1.7
Jan. 22	2.4	------	------	1.07	1.27	------	------	------	------	------	4.4
Jan. 23	1.0	------	------	------	------	------	------	------	------	.78	.7
Jan. 24	1.0	------	------	------	.98	------	1.00	------	------	------	1.0
Jan. 25	1.0	.90	1.00	1.10	1.36	------	1.37	1.27	------	------	1.1
Jan. 26	1.0	------	------	1.15	1.38	------	1.38	1.32	1.26	1.10	1.3
Jan. 28	1.3	------	------	1.10	1.50	------	------	------	------	------	1.1
Jan. 29	1.1	.85	1.00	1.19	1.45	------	1.43	1.36	1.29	1.22	1.2
Jan. 30	.9	.66	.99	1.10	1.46	------	1.46	1.16	1.02	------	.7
Jan. 31	.9	------	------	.77	.95	------	------	------	------	------	1.2
Means	------	.88	1.00	1.09	1.32	------	1.33	1.23	1.12	1.01	------

* Extrapolated.

Table 2 shows an excess in the amount of total solar and sky radiation at all stations, with the exception of Washington, Fresno, Twin Falls, Miami, and Riverside.

No polarization measurements were taken at either Washington or Madison, because of the presence of snow during observational days.

TABLE 2.—*Average daily totals of solar radiation (direct + diffuse) received on a horizontal surface*

Week beginning—	Washington	Madison	Lincoln	Chicago	New York	Fresno	Pittsburgh	Fairbanks	Twin Falls	La Jolla	Miami	New Orleans	Riverside	Blue Hill	Friday Harbor	Ithaca
	Gram-calories per square centimeter															
1936	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Jan. 29	177	229	229	157	152	228	178	49	217	202	351	174	221	272	166	232
Feb. 5	251	236	277	189	210	292	267	75	254	320	272	166	297	260	150	267
Feb. 12	168	256	269	116	125	221	148	80	246	221	246	282	210	145	212	191
Feb. 19	248	294	294	187	258	262	216	80	210	338	348	320	278	338	151	269
	Departures from weekly normals															
Jan. 29	−27	+41	+5	+38	+3	+32	----------	+13	+14	----------	0	−39	−46	+34	+16	+24
Feb. 5	+38	+29	+15	+53	+49	+44	----------	+26	+38	----------	−76	−35	+18	+10	+38	+61
Feb. 12	−54	+31	−3	−25	−43	−77	----------	+10	−41	----------	−103	+52	−87	−116	+93	−4
Feb. 19	−13	+40	−4	+4	+58	−72	----------	−24	−40	----------	−26	+62	−18	+47	+15	+61
	Accumulated departures on Feb. 25															
	−525	+1,092	−602	+175	+665	+378	----------	+231	−1,204	----------	−1,407	+938	−1,134	+693	+1,442	+952

TABLE 3.—*Total, I_m, and screened, I_y, I_r, solar radiation intensity measurements, obtained during February 1936, and determinations of the atmospheric turbidity factor, β, and water-vapor content, w=depth in millimeters, if precipitated*

AMERICAN UNIVERSITY, WASHINGTON, D. C.

Date and hour angle	Solar altitude	Air mass	I_m	I_y	I_r	$\beta_{I_{m-r}}$	$\beta_{I_{y-r}}$	β_{mean}	$\frac{I_{w=0}}{1.94}$	$\frac{I_{w=0}-I_m}{1.94}$	w	Air-mass type
									Percentage of solar constant			
Feb. 5, 1936	° ′	*m*	*gr. cal.*	*gr. cal.*	*gr. cal.*						*mm*	
1:20 a. m.	31 53	1.89	1.250	0.899	0.749	0.088	0.098	0.093	66.9	3.2	0.1	N_{rr} above.
1:04 a. m.	33 00	1.83	1.269	.900	.751	.098	.112	.095	67.4	3.7	.1	
Feb. 8, 1936												
2:32 a. m.	25 17	2.33	1.103	.867	.766	.170	.174	.172	48.7	----------	----------	P_c.
2:28 a. m.	25 48	2.29	1.114	.868	.766	.168	.181	.174	49.4	----------	----------	

Meteorological conditions during turbity measurements

Feb. 5. Temperature, −3° C.; wind, NW. 12; visibility, 50 miles; blueness of sky, 6.
Feb. 8. Temperature, −6° C.; wind NE. 9; visibility, 12 miles; blueness of sky, 4.

BLUE HILL METEOROLOGICAL OBSERVATORY OF HARVARD UNIVERSITY

Feb. 1, 1936												
3:00 a. m.	17 26	3.31	0.587	0.441	0.403	0.190	----------	0.190	42.9	3.5	1.8	P_c
0:12 a. m.	30 32	1.97	.781	.548	.470	.201	----------	.201	50.6	1.5	.8	
3:00 p. m.	17 26	3.31	.601	.446	.383	.154	0.178	.166	39.3	9.1	5.3	
Feb. 2, 1936												
2:21 a. m.	22 16	2.62	1.240	.869	.725	.041	.065	.053	70.3	8.2	4.9	P_c
0:48 a.m.	29 34	2.03	1.449	.974	.802	.020	.068	.044	75.3	2.8	1.8	
3:01 p. m.	17 25	3.31	1.325	.926	.767	.056	.027	.042	69.5	3.2	.9	
4:20 p. m.	----------	----------	1.036	.767	.667	----------	----------	----------	----------	----------	----------	
Feb. 3, 1936												
2:05 a. m.	24 14	2.45	1.288	.872	.738	.035	.100	.068	66.2	1.7	1.1	P_c
0:21 p. m.	30 42	1.95	1.370	.910	.745	.014	.074	.044	70.6	1.8	1.0	
Feb. 5, 1936												
0:28 p. m.	30 04	1.98	1.293	.883	.732	.036	.098	.067	71.0	6.3	3.1	P_c
3:00 p. m.	18 50	3.08	1.235	.875	.734	.029	.060	.044	66.8	4.9	2.8	
4:35 p. m.	----------	----------	.770	.586	.533	----------	----------	----------	----------	----------	----------	
Feb. 6, 1936												
1:33 a. m.	27 56	2.13	1.240	.867	.723	.064	.093	.078	67.3	5.2	2.2	P_c
0:50 p. m.	30 38	1.96	1.328	.907	.751	.047	.089	.068	69.2	2.7	1.7	
3:00 p. m.	18 35	3.11	1.225	.852	.716	.027	.066	.046	67.0	5.6	3.0	
4:35 p. m.	----------	----------	.756	.605	.499	----------	----------	----------	----------	----------	----------	
Feb. 8, 1936												
2:58 a. m.	19 18	3.00	1.143	.815	.711	.124	.110	.117	43.6	----------	----------	P_c
1:33 a. m.	31 50	1.89	1.283	.888	.742	.078	.104	.091	66.0	1.8	1.1	
0:14 p. m.	32 17	1.87	1.301	.942	.776	.037	.075	.056	72.1	2.4	1.6	
2:04 p. m.	25 40	2.30	1.313	.898	.761	.038	.066	.052	71.6	4.7	2.9	
4:08 p. m.	----------	----------	1.020	.739	.649	----------	----------	----------	----------	----------	----------	
Feb. 10, 1936												
2:50 a. m.	20 52	2.78	.596	.431	.399	.198	----------	.198	42.1	12.1	7.1	N_{rr}
0:11 p. m.	32 56	1.84	.886	.610	.530	.172	----------	.172	56.6	12.1	8.8	
3:00 p. m.	19 33	2.98	.764	.563	.488	.069	.020	.044	67.5	19.1	10.1	
Feb. 11, 1936												
3:05 a. m.	18 49	3.08	.808	.606	.530	.128	.138	.133	47.0	6.4	3.5	P_c
0:02 a. m.	33 19	1.82	1.129	.780	.677	.128	.125	.126	63.4	6.7	4.8	
Feb. 12, 1936												
3:08 a. m.	18 25	3.14	1.086	.776	.674	.092	.110	.086	55.5	1.0	0.4	P_c
0:17 a. m.	33 49	1.79	1.444	.953	.793	.027	.081	.054	75.2	2.7	1.8	
2:58 p. m.	20 43	2.81	1.342	.919	.769	.060	.090	.075	70.0	2.6	1.4	

TABLE 3.—*Total, I_m, and screened, I_y, I_r, solar radiation intensity measurements, obtained during February 1936, and determinations of the atmospheric turbidity factor, β, and water-vapor content, w=depth in millimeters, if precipitated*—Continued

BLUE HILL METEOROLOGICAL OBSERVATORY OF HARVARD UNIVERSITY—Continued

Date and hour angle	Solar altitude	Air mass	I_m	I_y	I_r	$\beta_{I_{m-r}}$	$\beta_{I_{y-r}}$	β_{mean}	$\frac{I_{y-r}}{1.94}$	$\frac{I_{m-r}-I_m}{1.94}$	w	Air-mass type
									Percentage of solar constant			
Feb. 19, 1936												
1:45 a. m.	30 55	1.94	1.336	0.908	0.760	0.050	0.104	0.077	69.5	2.2	1.7	P_c
0:28 p. m.	35 46	1.71	1.367	.918	.765	.027	.029	.028	81.4	12.2	9.2	
3:31 p. m.	17 11	3.35	1.152	.803	.688	.036	.072	.054	62.0	4.0	2.0	
Feb. 20, 1936												
3:06 a. m.	21 22	2.72	.980	.731	.621	.101	.142	.122	55.0	5.6	3.4	P_c
Feb. 21, 1936												
2:56 a. m.	23 12	2.52	.989	.724	.615	.148	.137	.142	58.9	6.4	4.7	N_{pc}
0:28 a. m.	36 21	1.69	1.238	.870	.725	.100	.068	.084	69.9	8.1	6.0	
0:13 p. m.	36 39	1.67	1.271	.796	.735	.093	------	.093	70.3	7.2	5.4	
1:52 p. m.	30 52	1.94	1,127	.786	.674	.108	.183	.146	58.6	3.6	2.4	
Feb. 22, 1936												
0:06 a. m.	36 46	1.67	1.228	.870	.715	.100	.100	.100	67.2	5.2	3.8	P_c
2:53 p. m.	23 25	2.51	1.311	.934	.759	.033	.024	.028	75.2	9.1	5.6	
Feb. 23, 1936												
2:45 a. m.	25 18	2.33	1.295	.922	.778	.062	.082	.072	66.0	.6	.2	P_c
0:48 a. m.	36 18	1.69	1.495	1.033	.828	.027	.025	.026	81.8	6.3	4.7	
3:27 p. m.	19 19	3.00	1.333	.952	.775	.016	.020	.018	75.2	7.9	4.4	
Feb. 24, 1936												
2:54 a. m.	23 35	2.50	1.300	.942	.778	.046	.050	.048	70.6	5.0	3.0	P_c
Feb. 28, 1936												
1:38 a. m.	34 34	1.76	1.326	.941	.772	.024	.076	.050	76.1	9.0	6.4	P_c
0:16 p. m.	39 10	1.58	1.419	.979	.794	.059	.045	.052	77.3	5.5	4.7	
2:04 p. m.	31 55	1.89	1.402	.939	.762	.018	.055	.036	74.0	2.6	2.4	
4:23 p. m.	11 38	4.87	1.113	.805	.683	.025	.025	.025	------	------	------	
Feb. 29, 1936												
1:44 a. m.	34 22	1.77	1.291	.877	.728	.071	.119	.095	68.6	3.2	2.1	N_{pc}
0:44 p. m.	38 43	1.60	1.384	.934	.752	.034	.049	.042	70.6	9.5	6.6	
2:12 p. m.	31 22	1.92	1.245	.867	.702	.061	.061	.061	73.8	10.8	7.7	
4:31 p. m.	10 32	5.35	.899	.662	.573	------	------	------	------	------	------	

Atmospheric conditions during solar radiation measurements, Blue Hill Observatory of Harvard University, Milton, Mass.

Date and time from apparent noon	Air temperature	Wind, Beaufort scale	Visibility (scale 0-10)	Sky blueness	Cloudiness and remarks
February 1936	°C.				
1; 0:38 a. m.	−9.7	W 4	7	7	T Ci, mod. dense haze.
2; 0:18 a. m.	−10.6	W 5	9	6	T Cu, light haze NE, wind gusty.
3; 2:11 a. m.	−13.6	W 3	8	7	1 Ci, light haze.
3; 0:29 a. m.	−9.9	W 3	9	8	T Ci, light haze.
5; 0:05 p. m.	−3.6	WSW 5	8	6	1 Ci, mod. haze, wind gusty.
6; 1:40 a. m.	−12.8	W 4	8	4	1 Ci, mod. haze, wind gusty, Ci too near sun.
6; 0:02 p. m.	−11.1	W 4	8	4	1 Ci, mod. haze, wind gusty.
8; 2:21 a. m.	−12.7	NNW 5	9	7	No clouds, light haze.
8; 0:35 a. m.	−9.3	NNW 5	9	7	No clouds, light haze, wind gusty.
10; 0:39 a. m.	−11.1	W 5	7	7	No clouds, mod. haze.
11; 1:38 a. m.	−10.6	W 4	8	7	No clouds, light-mod. haze.
12; 0:41 a. m.	−7.2	WNW 4	9	8	No clouds, light haze NE.
19; 0:05 p. m.	−13.2	WSW 4	8	8	T Acu, light haze.
20; 3:18 a. m.	−13.3	W 3	7	7	T Ci, mod. haze, Ci increasing rapidly and obscuring sun during test.
21; 2:15 a. m.	−8.3	WNW 4	6	7	3 Ci, mod. dense haze.
21; 0:49 a. m.	−5.7	NNW 4	6	7	3 Ci, mod. dense haze.
22; 0:23 a. m.	−7.0	N 4	8	6	6 Ci, mod. haze, Ci clouds nearing sun at end of observation.
23; 1:01 a. m.	−6.7	NW 4	9	7	T Ci, light haze NE.
28; 2:24 a. m.	−2.8	W 6	9	7	T Cu, l ght mod. haze.
28; 0:31 a. m.	−2.2	W 5	9	8	T Ci, T Cu, light mod. haze.
29; 2:44 a. m.	−4.7	E 2	8	7	T Ci, mod. heavy haze.
29; 0:01 a. m.	−0.8	ESE 3	8	7	T Ci, T Acu, mod. haze.

POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. J. F. Hellweg, U. S. Navy (Ret.), Superintendent U. S. Naval Observatory. Data furnished by the U. S. Naval Observatory in cooperation with Harvard and Mount Wilson Observatories. The difference in longitude is measured from the central meridian, positive west. The north latitude is positive. Areas are corrected for foreshortening and are expressed in millionths of the sun's visible hemisphere. The total area for each day includes spots and groups]

Date	Eastern standard time	Heliographic			Area		Total area for each day	Observatory
		Diff. in longitude	Longitude	Latitude	Spot	Group		
1936	h m	°	°	°				
Feb. 1	11 17	−55.0	270.8	+33.0	247	------	------	U. S. Naval.
		−42.0	283.8	+30.0	62	------	------	
		+29.0	354.8	−12.0	123	------	------	
		+70.0	35.8	+14.5	62	------	494	
Feb. 2	11 17	−42.0	270.6	+32.5	247	------	------	Do.
		−36.0	276.6	+23.0	------	108	------	
		−30.0	282.6	+30.0	31	------	------	
		+41.0	353.6	−13.0	123	------	509	
Feb. 3	13 15	−27.0	271.4	+34.0	------	240	------	Mt. Wilson.
		−24.0	274.4	−18.0	6	------	------	
		−19.0	279.4	+24.0	------	98	------	
		−14.0	284.4	+30.0	31	------	------	
		+41.0	339.4	−14.0	------	9	------	
		+56.0	354.4	−14.0	131	------	515	
Feb. 4	13 10	−85.0	200.2	−19.0	73	------	------	Do.
		−16.0	269.2	+32.0	------	209	------	
		−9.0	276.2	−18.5	3	------	------	
		−8.0	277.2	+22.0	------	170	------	
		−3.0	282.2	+29.0	8	------	------	
		+53.0	338.2	−11.0	------	82	------	
		+68.0	353.2	−12.0	102	------	647	

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard time	Heliographic			Area		Total area for each day	Observatory
		Diff. in longitude	Longitude	Latitude	Spot	Group		
1936	h m	°	°	°				
Feb. 5	11 12	−75.0	198.2	−21.0	15			U. S. Naval.
		−7.0	266.2	+33.0		201		
		+4.0	277.2	+23.0		247		
		+8.0	281.2	+30.0	15			
		+60.5	333.7	−17.0		77		
		+66.0	339.2	−11.0	46			
		+81.0	354.2	−12.0	62		663	
Feb. 6	13 54	−88.0	170.5	−26.0	154			Do.
		−59.0	199.5	−19.0	15			
		+8.0	266.5	+33.0		170		
		+19.0	277.5	+23.0		278		
		+76.0	334.5	−18.0		77	694	
Feb. 7	13 5	−75.0	170.9	−27.0		934		Mt. Wilson.
		−50.0	195.9	−20.0		26		
		+21.0	266.9	+32.0		138		
		+25.0	270.9	−11.0		8		
		+35.0	280.9	+22.0		363		
		+55.0	300.9	+13.0		49		
		+85.0	330.9	−18.0	73		1,591	
Feb. 8	11 4	−66.0	167.8	−27.0		802		U. S. Naval
		+33.0	266.8	+32.0	154			
		+49.0	282.8	+21.0	247			
		+59.0	292.8	+23.0		93		
		+68.0	301.8	+12.0		309	1,605	
Feb. 9	12 0	−53.0	167.1	−28.0		863		Mt. Wilson.
		−24.0	196.1	−21.0		10		
		+42.0	262.1	+32.0	140			
		+60.0	280.1	+22.0	322			
		+68.0	288.1	+24.0		26		
		+78.0	298.1	+12.0	326		1,687	
Feb. 10	10 59	−81.0	126.5	−31.0	108			U. S. Naval.
		−43.0	164.5	−27.0		772		
		−14.0	193.5	−22.0	15			
		+59.0	266.5	+33.0	139			
		+75.0	282.5	+22.0	185		1,219	
Feb. 11	13 11	−67.0	136.1	−32.0	185			Do.
		−28.0	165.1	−27.0		802		
		+61.0	254.1	−23.0		93		
		+70.0	263.1	+33.0	93		1,173	
Feb. 12	9 22	−55.0	127.0	−29.5	149			Harvard.
		−22.5	159.5	−23.5		58		
		−22.0	160.0	−26.5		90		
		−8.0	174.0	−24.5		329	626	
Feb. 14	13 22	−29.5	124.0	−31.5	247			U. S. Naval.
		−7.0	146.5	+11.5		123		
		+11.0	164.5	−27.0		617	987	
Feb. 15	12 23	−56.0	84.9	+15.5	31			Do.
		−18.0	122.9	−32.0	247			
		+6.0	146.9	+12.0		123		
		+19.0	159.9	+19.0		46		
		+25.0	165.9	−27.0		525	972	
Feb. 18	11 15	−50.0	52.0	−17.5	185			Do.
		−49.0	53.0	+19.0		154		
		−11.0	91.0	+16.5		62		
		+19.5	121.5	−33.0	216			
		+50.0	152.0	+11.0	31			
		+59.5	161.5	−27.5		463	1,111	
Feb. 19	11 4	−38.0	50.9	−17.0	139			Do.
		−36.0	52.9	+19.0		123		
		+1.0	89.9	+13.0	23			
		+32.0	120.9	−34.0	247			
		+62.0	150.9	+11.0	31			
		+65.0	153.9	−27.0		46		
		+80.0	168.9	−26.0	154		763	
Feb. 20	12 33	−20.5	54.5	−16.0		137		Harvard.
		−19.5	55.5	+18.0	138			
		+46.0	121.0	−35.0	267		542	
Feb. 21	12 18	−74.5	347.5	−5.5	198			Do.
		−57.5	4.5	−19.0	51			
		−45.0	17.0	−28.0		202		
		−14.0	48.0	−31.0		120		
		−7.5	54.5	−16.0	105			
		−6.0	56.0	+18.0		158		
		+58.0	120.0	−35.0	340		1,174	
Feb. 22	11 14	−61.0	348.3	−8.0		123		U. S. Naval.
		−47.0	2.3	−23.0	39			
		−35.0	14.3	−31.0		216		
		−3.0	46.3	−31.5		154		
		+1.0	50.3	−18.0		108		
		+3.0	52.3	+18.0		93		
		+70.0	119.3	−33.0	93		826	

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard time	Heliographic			Area		Total area for each day	Observatory
		Diff. in longitude	Longitude	Latitude	Spot	Group		
1936	h m	°	°	°				
Feb. 24	11 4	−70.0	313.1	+12.5	123			U.S. Naval
		−35.0	348.1	−8.5		216		
		−21.0	2.1	−22.0	15			
		−14.0	9.1	−32.0		62		
		−6.0	17.1	−31.0		123		
		+25.0	48.1	−32.0	93			
		+29.0	52.1	−19.0	139			
		+29.5	52.6	+16.0		185	956	
Feb. 25	13 0	−55.0	313.8	+13.0	123			Do.
		−22.0	346.8	−8.0		154		
		+8.5	17.3	−31.0	108			
		+39.0	47.8	−32.5	77			
		+43.0	51.8	−19.0	123			
		+43.0	51.8	+15.0		370	955	
Feb. 26	13 17	−80.0	275.5	−18.0		93		Do.
		−41.0	314.5	+12.0	139			
		−9.0	346.5	−9.0		154		
		+21.0	16.5	−30.5		62		
		+51.0	46.5	−32.0	93			
		+54.0	49.5	+16.0		370		
		+56.0	51.5	−18.0	123		1,034	
Feb. 27	15 42	−66.0	275.0	−18.0		247		Do.
		−27.0	314.0	+12.0	154			
		+6.5	347.5	−8.5		62		
		+36.0	17.0	−30.0		93		
		+65.0	46.0	−32.0	77			
		+66.0	47.0	+15.5		309		
		+71.0	52.0	−18.0	123		1,065	
Feb. 28	11 1	−63.0	267.4	+23.0	46			Do.
		−54.0	276.4	−18.0		278		
		−15.0	315.4	+12.0	154			
		+18.0	348.4	−8.5		62		
		+47.0	17.4	−30.5		77		
		+77.0	47.4	+14.0		247		
		+82.0	52.4	−18.0	77		941	
Feb. 29	10 43	−49.0	268.4	+22.5		123		Do.
		−41.0	276.4	−18.0		139		
		−2.0	315.4	+12.0	123			
		+30.5	347.9	−8.0		46		
		+60.0	17.4	−30.5		93	524	

Mean daily area for 25 days, 931.

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR FEBRUARY 1936

[Dependent alone on observations at Zurich and its station at Arosa]

[Data furnished through the courtesy of Prof. W. Brunner, Eidgen. Sternwarte, Zurich, Switzerland]

February 1936	Relative numbers	February 1936	Relative numbers	February 1936	Relative numbers
1	45	11	60	21	*Eccd*111
2	*Ec*45	12	91	22	*aaa*97
3	46	13	*b*69	23	87
4	43	14	*Mc*77	24	*d*109
5	*Wac*67	15	*a*77	25	*a*90
6	*a*56	16	*d*91	26	*d*97
7	*Wcd*61	17	*a*58	27	*a*91
8	93	18	55	28	*Ec*—
9	84	19	56	29	64
10	*a*73	20	74		

Mean, 28 days=73.8.

a=Passage of an average-sized group through the central meridian.
b=Passage of a large group or spot through the central meridian.
c=New formation of a center of activity: *E*, on the eastern part of the sun's disk; *W*, on the western part; *M*, in the central circle zone.
d=Entrance of a large or average-sized center of activity on the east limb.

AEROLOGICAL OBSERVATIONS

[Aerological Division, D. M. LITTLE, in charge]

By L. T. SAMUELS

At those stations with a sufficient period of record for the determination of approximate normals, upper-air temperatures during February averaged below normal. (See table 1.) Exceptionally large departures occurred from the surface to 1,500 meters at Omaha. While the departures at Seattle were likewise exceptionally large, there were too few observations made during the month at that station to determine reliable means. Mean temperatures for the month were considerably lower over the north-central part of the country than over corresponding latitudes in the eastern and western sections.

Upper-air relative humidities averaged mostly above normal, as indicated in table 1.

The directions of the upper-air wind resultants contained greater northerly components than normal in the lower levels at a number of stations, especially in the north-central section. Elsewhere these directions were close to normal. Resultant velocities exceeded the normals at nearly all stations, with the departures increasing to moderately large values at the high levels.

TABLE 1.—*Mean free-air temperatures and relative humidities obtained by airplanes during February 1936*

TEMPERATURE (° C.)

Stations	Altitude (meters) m. s. l.																Number of observations
	Surface		500		1,000		1,500		2,000		2,500		3,000		4,000		5,000		
	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	
Barksdale Field (Shreveport), La.[1] (52 m)	3.7		5.2		5.7		5.6		4.2		2.4		0.2		−5.8		−12.1		23
Billings, Mont.[2] (1088 m)	−18.2						−14.3		−13.2		−13.4		−15.2		−21.9		−28.9		27
Cheyenne, Wyo.[3] (1,873 m)	−9.9								−9.6		−9.2		−11.7		−18.4		−25.9		20
El Paso, Tex.[3] (1,194 m)	7.6						9.6		7.2		3.4		.6		−5.7		−12.3		29
Fargo, N. Dak.[3] (274 m)	−25.6		−22.8		−21.0		−19.2		−19.2		−19.8		−21.4		−26.7		−32.4		24
Kelly Field (San Antonio), Tex.[1] (206 m)	5.6		7.5		9.3		10.5		9.1		6.3		2.8		−3.8		−11.4		19
Lakehurst, N. J.[3] (39 m)	−5.1		−7.3		−7.7		−8.3		−9.6		−11.1		−13.2		−18.7		−25.4		21
Maxwell Field (Montgomery), Ala.[1] (52 m)	6.9		6.0		4.2		3.7		2.6		.5		−1.8		−7.0		−13.3		19
Mitchell Field (Hempstead, Long Island), N. Y.[1] (29 m)	−7.4		−7.8		−7.9		−8.3		−9.3		−10.9		−12.9		−17.1		−24.0		22
Murfreesboro, Tenn.[3] (174 m)	−.7		−.6		−1.0		−1.3		−2.4		−4.2		−6.2		−11.6		−18.3		27
Norfolk, Va.[3] (10 m)	1.6	−1.8	3.3	0	1.6	−0.4	−.2	−0.7	−2.1	−1.0	−4.1	−0.9	−6.3	−1.0	−10.6	−0.6	−16.8	−1.0	13
Oklahoma City, Okla.[3] (391 m)	−3.0		−1.7		−.9		2.1		1.5		−.3		−3.4		−9.6		−16.0		28
Omaha, Nebr.[3] (300 m)	−15.9	−9.2	−15.3	−9.5	−11.3	−7.7	−8.8	−6.0	−8.4	−4.8	−9.4	−3.8	−11.6	−3.5	−17.7	−3.7	−24.7	−4.2	27
Pearl Harbor, Territory of Hawaii[3] (6 m)	19.6	−2.0	19.0	−.5	15.4	−.3	12.4	−.7	10.6	−.6	9.5	−.1	6.2	−1.1	−.2	−1.7	−9.6	−5.1	29
Pensacola, Fla.[3] (0 m)	9.2	−.9	9.6	−.9	9.1	0	7.9	+.4	5.8	+.3	3.3	0	.9	−.1	−4.6	−.1	−11.6	−.4	26
San Diego, Calif.[3] (10 m)	10.6	−1.5	11.0	−.9	8.8	−1.4	6.5	−1.4	4.0	−1.5	1.8	−1.3	−.6	−1.1	−6.0	−.5	−12.1	0	28
Scott Field (Belleville), Ill.[1] (135 m)	−9.3		−8.0		−5.6		−4.0		−5.5		−7.8		−9.9		−15.9		−22.2		17
Seattle, Wash.[3] (10 m)	−.2	−6.5	−5.5	−10.1	−6.9	−8.8	−8.5	−7.7	−9.8	−6.4	−10.7	−4.8	−12.9	−4.2	−18.8	−5.1	−25.5	−6.1	5
Spokane, Wash.[3] (596 m)	−10.3				−9.4		−9.9		−10.7		−12.6		−15.0		−20.7		−26.6		28
Washington, D. C.[3] (13 m)	−5.6	−5.6	−4.1	−3.9	−5.2	−3.6	−6.1	−3.3	−6.7	−2.6	−8.0	−2.1	−9.8	−1.9	−14.3	−1.3	−19.4	−1.0	20
Wright Field (Dayton), Ohio[1] (244 m)	−8.0		−7.9		−7.5		−6.8		−7.9		−9.9		−12.1		−17.2		−23.2		23

RELATIVE HUMIDITY (PERCENT)

Barksdale Field (Shreveport), La.	73		63		54		50		44		41		41		40		38		
Billings, Mont.	57						54		55		60		65		73		70		
Cheyenne, Wyo.	69								66		61		63		61		58		
El Paso, Tex.	43						41		42		44		40		33		30		
Fargo, N. Dak.	76		75		71		65		59		56		57		59		60		
Kelly Field (San Antonio), Tex.	76		71		67		52		43		42		42		37		40		
Lakehurst, N. J.	63		59		57		56		57		56		51		42		38		
Maxwell Field (Montgomery), Ala.	64		54		51		47		39		36		35		32		30		
Mitchel Field (Hempstead, Long Island), N. Y.	64		59		56		54		55		57		55		52		52		
Murfreesboro, Tenn.	79		75		71		64		61		59		55		56		56		
Norfolk, Va.	72	+1	61	−2	55	−3	52	−2	49	−1	46	−2	45	−1	46	+4	45	+6	
Oklahoma City, Okla.	67		64		53		46		44		45		47		48		44		
Omaha, Nebr.	63	−14	62	−11	57	−5	54	−2	53	+1	54	+2	55	+3	57	+7	55	+8	
Pearl Harbor, Territory of Hawaii.	85	+10	80	+5	83	+4	77	+5	64	+3	48	0	41	+3	31	+3	22	+2	
Pensacola, Fla.	83	+3	75	+5	67	+1	54	−5	46	−8	46	−5	48	0	35	−6	31	−7	
San Diego, Calif.	91	+15	79	+11	71	+11	60	+8	53	+7	45	+4	41	+4	37	+3	35	+3	
Scott Field (Belleville), Ill.	75		68		60		57		56		57		56		57		55		
Seattle, Wash.	64	−9	76	+7	77	+10	76	+10	75	+11	73	+13	70	+13	71	+14	74	+13	
Spokane, Wash.	78				77		73		70		68		66		62		57		
Washington, D. C.	73	+1	60	−4	62	+1	60	+2	56	+1	56	+2	53	+1	48	−1	50	+2	
Wright Field (Dayton), Ohio	76		76		75		67		62		61		59		54		54		

Late report for November 1935

TEMPERATURE (°C.)

Pearl Harbor, Territory of Hawaii[3] (6 m)	21.6	−3.0	21.3	−0.3	17.6	−0.2	14.3	−0.7	11.8	−1.1	10.1	−0.9	7.8	−1.0	2.2	−0.9			30

TABLE 1.—*Mean free-air temperatures and relative humidities obtained by airplanes during February 1936*—Continued

RELATIVE HUMIDITY (PERCENT)

Stations	Altitude (meters) m. s. l.																		Number of observations
	Surface		500		1,000		1,500		2,000		2,500		3,000		4,000		5,000		
	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	
Pearl Harbor, Territory of Hawaii	84	+11	77	+2	81	+2	80	+5	73	+6	57	+2	47	+1	34	−1	------	------	------

Late report for January 1936

TEMPERATURE (°C.)

Pearl Harbor, Territory of Hawaii[3] (6 m)	20.7	−1.7	20.3	+0.5	16.6	+0.7	13.5	+0.3	11.7	+0.5	10.1	+0.7	7.2	+0.3	1.9	+0.2	------	------	31

RELATIVE HUMIDITY (PERCENT)

Pearl Harbor, Territory of Hawaii	85	+11	80	+5	84	+6	79	+8	62	+2	46	−2	41	+1	28	−1	------	------	------

[1] Army.
[2] Weather Bureau.
[3] Navy.

Observations taken about 4 a. m., 75th meridian time, except along the Pacific coast and Hawaii where they are taken at dawn.

NOTE.—The departures are based on "normals" covering the following total number of observations made during the same month in previous years, including the current month: Norfolk 120; Omaha 136; Pensacola 123; San Diego 151; Seattle 58; Washington 169; Pearl Harbor (November 1935) 114; Pearl Harbor (January 1936) 122; Pearl Harbor (February 1936) 122.

TABLE 2.—*Free-air resultant winds (meters per second) based on pilot-balloon observations made near 5 a. m. (E. S. T.) during February 1936*

[Wind from N=360°, E=90°, etc.]

Altitude (m) m. s. l.	Albuquerque, N. Mex. (1,554 m)		Atlanta, Ga. (309 m)		Billings, Mont. (1,088 m)		Boston, Mass. (15 m)		Cheyenne, Wyo. (1,873 m)		Chicago, Ill. (192 m)		Cincinnati, Ohio (153 m)		Detroit, Mich. (204 m)		Fargo, N. Dak. (274 m)		Houston, Tex. (21 m)		Key West, Fla. (11 m)		Medford, Oreg. (410 m)		Murfreesboro, Tenn. (180 m)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	------
Surface	257	2.3	342	1.5	283	1.0	290	2.6	245	4.4	288	2.0	305	1.2	262	1.6	314	1.8	29	2.1	116	1.3	277	0.3	246	0.7
500	-----	-----	342	1.7	-----	-----	305	10.6	-----	-----	273	3.4	242	3.2	270	2.2	319	4.5	87	2.2	153	4.4	205	.5	210	3.4
1,000	-----	-----	305	1.8	-----	-----	313	12.3	-----	-----	271	8.1	257	9.3	265	6.8	303	6.8	226	2.7	170	4.7	210	2.4	248	7.0
1,500	-----	-----	272	7.4	238	5.1	296	13.4	-----	-----	292	9.6	262	11.8	268	8.4	299	8.5	264	5.7	199	4.8	221	4.0	289	7.8
2,000	286	5.1	274	11.4	269	7.9	293	14.2	249	7.0	288	11.8	280	12.3	272	10.6	292	10.6	276	7.2	235	4.8	241	6.2	280	12.3
2,500	291	8.0	280	13.0	283	9.8	288	12.5	266	14.4	291	14.4	-----	-----	281	11.7	292	13.5	277	8.3	264	6.1	249	6.4	279	15.2
3,000	290	11.5	284	13.8	279	14.1	286	13.3	275	17.0	280	11.4	-----	-----	-----	-----	297	12.5	285	12.9	275	10.0	278	6.9	-----	-----
4,000	282	15.9	-----	-----	280	16.6	-----	-----	279	15.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	287	9.1	-----	-----
5,000	275	16.7	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Altitude (m) m. s. l.	Newark, N. J. (14 m)		Oakland, Calif. (8 m)		Oklahoma City, Okla. (402 m)		Omaha, Nebr. (306 m)		Pearl Harbor, Territory of Hawaii[1] (68 m)		Pensacola, Fla.[1] (24 m)		St. Louis, Mo. (170 m)		Salt Lake City, Utah (1,294 m)		San Diego, Calif. (15 m)		Sault Ste. Marie, Mich. (198 m)		Seattle, Wash. (14 m)		Spokane, Wash. (603 m)		Washington, D. C. (10 m)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	299	2.9	186	2.5	138	0.6	337	2.1	350	0.9	39	3.3	276	0.7	174	3.9	30	0.5	257	1.3	125	0.6	194	1.0	331	1.4
500	311	6.7	222	3.4	168	4.0	338	3.0	232	1.6	102	2.9	251	3.8	-----	-----	280	1.3	279	5.2	225	1.2	-----	-----	301	5.1
1,000	299	10.2	248	3.9	243	6.9	314	6.6	236	2.8	219	1.3	263	9.1	-----	-----	301	1.9	288	6.5	265	2.0	204	2.0	290	8.0
1,500	293	11.6	257	4.1	260	7.8	287	8.9	249	3.2	255	3.6	283	12.5	182	6.4	306	4.7	281	7.9	263	3.3	235	3.0	288	11.3
2,000	285	11.6	268	4.8	265	9.9	283	10.8	276	3.9	276	6.0	282	11.7	222	5.4	299	6.3	283	10.5	286	4.6	259	5.2	279	11.9
2,500	285	12.0	304	4.2	276	9.9	284	12.4	262	2.9	284	8.1	287	12.4	259	6.9	293	8.1	284	11.4	310	7.2	279	7.8	270	14.8
3,000	-----	-----	306	7.2	284	10.7	285	14.8	297	3.7	274	8.2	286	16.7	269	9.9	294	9.9	-----	-----	318	11.3	286	10.0	-----	-----
4,000	-----	-----	-----	-----	278	15.1	-----	-----	-----	-----	-----	-----	-----	-----	289	11.3	301	9.0	-----	-----	-----	-----	295	12.2	-----	-----
5,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	299	7.4	-----	-----	-----	-----	-----	-----	-----	-----

[1] Navy stations.

RIVERS AND FLOODS

[River and Flood Division, MONTROSE W. HAYES, in charge]

By W. J. MOXOM

The floods in the upper Mississippi Basin and on the Atlantic Seaboard, in which snow and ice played a part, and the later floods caused by the eastern storm of March 16–19, will be discussed in a separate article which will appear or be referred to in a future issue of the REVIEW.

The severe cold spell that began January 22, in the North-Central States, caused a rapid freezing of the rivers; and by the end of February, ice was probably heavier in most of the States east of the Rocky Mountains and north of latitude 36° than at any time since February 1918.

The Missouri River in the vicinity of Kansas City, Mo., was frozen from bank to bank from January 31 to February 24, 1936, inclusive. This is the first time since the winter of 1911–12 the river at Kansas City has been frozen across.

Ohio River navigation in the vicinity of Cincinnati was stopped by ice on January 26, and remained suspended until February 14, when it was partly resumed; it was fully resumed on February 24. From Virginia northward, most of the rivers were frozen, except for swiftly running water, and the ice was unusually heavy. Also, a large part of Chesapeake Bay above the mouth of the Rappahannock River was frozen.

In addition to the thick ice in the rivers, the watersheds of most of the streams were covered with heavy snow; and there was considerable fear that floods would follow the breaking of ice and melting of snow. During the month the ice broke and moved out of the rivers in Virginia, Maryland, and Pennsylvania, and out of the Ohio River and most of its tributaries, the Mississippi River below Keokuk, Iowa, and the Missouri River below St. Joseph, Mo. Gorged ice caused rather severe local flooding in the James River in the vicinity of Richmond, Va., in the rivers of Pennsylvania, including the extreme upper Ohio River and its tributaries, and in the Ohio River near Evansville, Ind. The estimated total damage from flooding due to ice movement was slightly less than $700,000. The greatest damage occurred in the extreme upper Ohio, and its tributaries above Pittsburgh, Pa., in the Ohio and its tributaries near Evansville, Ind., and in the interior rivers of Ohio and Indiana.

At the close of the month the ice was intact in the upper Missouri and the upper Mississippi Rivers, and in the rivers of New York and New England.

Freshets occurred during February in most of the rivers in the Southeastern States, including Tennessee, and in the Sacramento River system in California. The rivers in Georgia, Alabama, and Mississippi were in high flood, and caused damage in excess of $500,000. In the remainder of the Southeastern States, including Tennessee, the estimated damages were considerably less and did not exceed $40,000.

Heavy rainfall over the watersheds of the Sacramento River system in California, together with melting snow in the vicinity of the 5,000-foot level, caused severe floods in the Sacramento River and several of its tributaries. The total estimated damage was in excess of $800,000.

In practically all districts, flood warnings were timely and were the means of large savings, estimated to be in excess of $2,000,000.

The following remarks have been extracted from the reports prepared at the district centers in those regions in which freshets occurred:

Raleigh, N. C.—Damage was not heavy, owing to previous floods and continued high water on the Coastal Plain.

Charleston, S. C.—No damage was reported, except an estimate of loss in prospective crops of $800.

Columbia, S. C.—No damage reported; but logging operations on the Santee River were suspended most of the month, as the Santee stages were near or somewhat above flood in the latter part of January and almost all of February. In the other rivers of the district, stages were only slightly above flood levels for short periods and no damages were reported.

Augusta, Ga.—The Savannah River was in moderate flood below Augusta through the greater part of the month, and the Ogeechee River was slightly above flood stage for short periods. Total estimated damage was $2,000.

Macon, Ga.—Excessive rains in the first week of February caused the third flood crest in the Altamaha system since January 1. The Altamaha River was above flood stage during the entire month. Total estimated flood damage in the district was $18,500.

Atlanta, Ga.—The Chattahoochee, Flint, and Apalachicola Rivers were in moderate flood during the early part of month. Estimated flood damage $16,700.

Montgomery, Ala.—Heavy rains over the watersheds in the Montgomery River district on the afternoon and night of February 3 melted snow over the upper reaches, and the combined run-off caused the highest stages recorded since the flood of 1929. The heaviest damage was borne by the highway department and the railroads. Roads and rights-of-way, fills, bridges, etc., were badly washed and seriously damaged in many places, on the small as well as on the larger streams. The total estimated damage, including suspension of business ($23,275), amounted to $382,050, and the money value of property saved by flood warnings was about $98,800.

Pensacola, Fla.—Flood stage was reached at Caryville, Fla., on the Choctawhatchee River, on February 8 and 17. Damage was negligible.

Mobile, Ala.—Excessive rainfall over the watersheds of the Black Warrior and Tombigbee Rivers on the afternoon and night of February 3 caused a moderately high flood in those rivers. Total estimated damage was $18,810.

Meridian, Miss.—The month of February opened with moderate to strong flow in the rivers, and with swamps and small streams full or nearly full; and heavy to very heavy rains occurred from February 2 to 4 over the whole district. The heavy rainfall over the upper Chickasawhay and upper Leaf watersheds caused severe floods in both of these rivers, and in the Pascagoula River, formed by their confluence. The flood at Enterprise, Miss., was the most severe since December 10, 1919. At Shubuta, Miss., it equaled, or exceeded, the flood of March 1929, by possibly a few hundredths of a foot. At Hattiesburg, Miss., the crest was about 0.9 foot less than the crest of March 1935. The rainfall was not so heavy over the Pearl River watershed, and only moderate flooding occurred in that river. The total estimated damage for the entire district, comprising the Pascagoula and Pearl River systems, was

$229,000, including an estimated damage of $50,000 in and around Meridian, Miss., which was flooded to a considerable extent by overflows from Sowashee, Chunky and Okatibee Creeks.

Asheville, N. C.—Overflows occurred only at the lowest places in banks near and above Asheville. There was no damage.

Knoxville, Tenn.—There were moderate floods in the Little and Pigeon Rivers and the French Broad in Tennessee, with total damages estimated at $10,000.

Chattanooga, Tenn.—There were moderate floods in the Little Tennessee, Hiwassee, and Tennessee Rivers. Newspapers report the failure of an earthen dam near Murphy, N. C., on a small tributary of the Hiwassee River, and the drowning of two persons. Highway traffic was inconvenienced to some extent. Estimated damage not reported.

Sacramento, Calif.—Due to heavy rains over the watersheds of the Sacramento River system, and the melting of snow in the vicinity of the 5,000-foot elevation, the river reached the highest level since March 1928, with flood stages exceeded at Red Bluff and Knights Landing. The Cosumnes and lower Mokelumne Rivers were at or above flood stage for about a week; the highest stage at Bensons Ferry, on the Mokelumne, was 2 feet above flood and the highest since March 1911. The San Joaquin also was high, but did not reach flood stage.

Heavy rains in a few of the foothills caused moderate damage to highways and railroads by wash-outs. Overflowing creeks and other minor waterways covered lowlands in numerous parts of the valleys, and interfered with highway traffic. This was notably true in the Stockton district. Several minor breaks in the levees of the Stanislaus and the San Joaquin Rivers resulted in the flooding of about 3,000 acres near the confluence of these streams. Also, water flowing through old breaks in the levee north of Colusa inundated areas, in addition to those flooded in January, on the east side of the river in the Colusa-Moulton Weir section. In most of these water-covered lands, which are largely pasture, orchard, and grain areas, no great damage will result, especially if the water drains off without great delay.

The heaviest damage was sustained on Liberty and Prospect Islands in the lower Yolo Bypass, and on a few scattered island tracts in the San Joaquin-Mokelumne delta region, all of which were flooded by the combined effect of freshet water and tides. These islands, about nine in number, were mostly planted to asparagus and other valuable crops. Approximately 6,000 acres of asparagus were under water.

At 5 p. m. of the 22d, when additional rains were in prospect, 42 flood-control gates of the Sacramento Weir, 3 miles above Sacramento, were opened. The river at Sacramento, under the influence of the American, had been rising, but was stationary at 28.7 feet for 2½ hours prior to the opening of the gates. When the gates were opened the river at Sacramento began to fall rapidly and at midnight the gage read 25.8 feet. Meanwhile the Feather River was unusually high and was discharging heavily. The 6 remaining gates of the weir were opened on the morning of the 23d. All the weir gates were closed on the 29th.

Creeks in the foothills of Amador and El Dorado Counties became torrents as the result of excessively heavy local rains. Considerable damage was done; and two men, while attempting to cross Rancheria Creek near Amador City, lost their lives when their automobile was swept from a small bridge over the stream; the bridge was washed out later. It was also reported that a man in Colusa County perished while attempting to cross Stony Creek with a team of horses.

The total estimated damage from these floods in the Sacramento and San Joaquin River systems exceeded $800,000.

Table of flood stages during February 1936

[All dates in February unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
ST. LAWRENCE DRAINAGE					
Lake Erie					
	Feet			*Feet*	
St. Marys: Decatur, Ind.	15	25	Mar. 1	19.5	27
St. Joseph: Fort Wayne, Ind.	12	26	Mar. 2	16.3	27
Maumee:					
Fort Wayne, Ind.	15	26	Mar. 2	21.0	27
Napoleon, Ohio	10	26	Mar. 2	19.4	28
Sandusky: Upper Sandusky, Ohio	13	27	28	13.8	27
ATLANTIC SLOPE DRAINAGE					
Potomac: Sycamore Island, Md.	10	28	29	12.3	28
James:					
Columbia, Va.	10	15	22	22.95	16
		28	(1)	11.7	29
Richmond, Va.	8	Jan. 30	12	16.9	8
		14	18	15.5	15
Dan:					
Danville, Va.	11	15	15	12.2	15
Clarksville, Va.	13	16	17	14.8	17
Roanoke:					
Randolph, Va.	18	15	17	26.8	16
Weldon, N. C.	31	15	20	43.0	18
Williamston, N. C.	10	7	Mar. 3	13.9	22
Fishing Creek: Enfield, N. C.	14	15	18	15.0	17
Tar:					
Rocky Mount, N. C.	8	6	7	8.3	7
		14	19	10.6	18
Tarboro, N. C.	18	16	23	23.8	20
Greenville, N. C.	13	9	25	17.7	21
Neuse:					
Neuse, N. C.	14	6	7	14.8	7
		14	20	19.1	17
Smithfield, N. C.	13	5	9	15.8	6
		14	22	19.9	17
Haw: Moncure, N. C.	20	14	16	23.6	15
Cape Fear:					
Fayetteville, N. C.	35	6	6	36.0	6
		15	18	45.7	16
Lock No. 2, Elizabethtown, N. C.	20	5	10	27.8	7
		15	22	31.7	18
Lynches: Effingham, S. C.	14	11	11	14.0	11
Peedee:					
Cheraw, S. C.	30	5	6	32.4	6
		15	17	37.4	15
Mars Bluff Bridge, S. C.	17	7	26	(20.4	10
				(22.0	20
Poston, S. C.	18	9	29	(20.2	12, 13
				(21.9	22
Saluda:					
Pelzer, S. C.	6	4	9	9.1	5
		15	15	6.0	15
Chappells, S. C.	13	4	8	19.3	5
		14	15	13.9	14
Broad: Blairs, S. C.	14	4	6	17.9	5
		15	15	16.2	15
Catawba: Catawba, S. C.	11	5	5	11.0	5
		15	15	11.4	15
Wateree: Camden, S. C.	23	5	6	25.4	5
		15	16	24.4	15
Santee:					
Rimini, S. C.	12	1	2	13.0	1
		5	(1)	17.1	10
Ferguson, S. C.	12	1	(1)	14.0	10-12, 21
Broad: Carlton, Ga.	15	5	5	16.9	5
Savannah:					
Ellenton, S. C.	14	5	27	25.6	7
Clyo, Ga.	13	1	4	15.4	1
		10	29	19.3	12
Ogeechee:					
Midville, Ga.	6	8	10	6.9	9
Dover, Ga.	7	1	2	7.3	1
		7	27	9.3	12
Ocmulgee:					
Macon, Ga.	18	4	7	20.6	6
Hawkinsville, Ga.	25	9	10	26.1	9
Abbeville, Ga.	11	7	23	15.9	11
Lumber City, Ga.	15	14	19	17.4	15
Oconee:					
Milledgeville, Ga.	22	4	9	26.1	5
Dublin, Ga.	22	8	12	24.0	9
Altamaha:					
Charlotte, Ga.	12	1	29	21.4	15
Everett City, Ga.	10	1	29	13.2	21

1 Continued into March.

Table of flood stages during February 1936—Continued

[All dates in February unless otherwise specified]

River and staton	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
EAST GULF OF MEXICO DRAINAGE					
Chattahoochee:	*Feet*			*Feet*	
Norcross, Ga.	16	5	6	19.4	6
West Point, Ga.	19	5	6	20.8	5
Columbus, Ga.	34	5	6	35.0	5
Eufaula, Ala.	40	5	9	44.7	7
Columbia, Ala.	42	7	8	43.0	8
Alaga, Ala.	32	6	11	38.2	8
Flint:					
Albany, Ga.	20	8	14	23.4	10
		17	17	20.3	17
Bainbridge, Ga.	25	12	14	25.2	13
Apalachicola:					
River Junction, Fla.	20	8	13	22.8	10
		16	17	20.1	16
Blountstown, Fla.	15	1	29	22.4	11
Choctawhatchee: Caryville, Fla.	12	9	10	12.0	9, 10
		17	19	12.4	17
Coostanaula:					
Resaca, Ga.	22	4	8	30.8	6
Rome, Ga.	25	4	10	33.3	6
Etowah: Canton, Ga.	17	4	5	23.2	5
Coosa:					
Mayos Bar Lock, Ga.	28	5	10	36.7	6
Gadsden, Ala.	20	5	15	28.4	10
Lock No. 4, Lincoln, Ala.	17	4	15	24.0	5
Wetumpka, Ala.	45	4	10	52.3	7
Tallapoosa: Milstead, Ala.	40	5	6	45.2	5
Alabama:					
Montgomery, Ala.	30	5	11	52.9	7
Selma, Ala.	35	5	19	53.3	10
Millers Ferry, Ala.	40	5	21	53.0	12, 13
Black Warrior: Lock No. 10, Tuscaloosa, Ala.	46	4	9	63.5	4
Tombigbee:					
Lock No. 4, Demopolis, Ala.	39	4	22	61.8	11
Lock No. 3.	33	4	25	59.7	13
Lock No. 2.	46	4	23	61.3	14
Lock No. 1.	31	4	27	41.7	17
Leaf: Hattiesburg, Miss.	18	6	9	21.9	7
Chickasawhay:					
Enterprise, Miss.	20	4	7	35.7	5
Shubuta, Miss.	26	4	11	40.45	7
Pascagoula: Merrill, Miss.	22	8	15	25.4	11
Bogue Chitto: Franklinton, La.	10	6	7	16.0	6
Pearl:					
Edinburg, Miss.	20	4	11	25.4	7
Jackson, Miss.	18	4	22	32.5	12
Monticello, Miss.	15	4	23	22.6	4
Columbia, Miss.	17	5	24	22.1	8
Pearl River, La.	12	7	(1)	15.8	10
MISSISSIPPI SYSTEM					
Upper Mississippi Basin					
Skunk: Augusta, Iowa.	15	26	26	15.8	26
Des Moines: Des Moines, Iowa.	9	27	27	9.5	27
Fox: Wayland, Mo.	14	25	26	16.94	26
Salt: New London, Mo. (near)	19	27	29	22.7	28
Mississippi:					
Hannibal, Mo.	13	27	28	13.72	27
Louisiana, Mo.	12	27	29	13.8	28
Missouri Basin					
Grand:					
Gallatin, Mo.	20	25	27	23.07	25
Chillicothe, Mo.	18	25	28	25.61	27
Ohio Basin					
Allegheny:					
Warren, Pa.	12	27	27	12.5	27
Parkers Landing, Pa.	20	27	27	25.8	27
Lock No. 8, Mosgrove, Pa.	24	28	28	34.0	28
Lock No. 5, Schenley, Pa.	24	28	28	31.7	28
Lock No. 4, Natrona, Pa.	24	28	28	28.7	28
Lock No. 3, Springdale, Pa.	25	28	28	28.7	28

[1] Continued into March.

Table of flood stages during February 1936—Continued

[All dates in February unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
MISSISSIPPI SYSTEM—continued					
Ohio Basin—Continued					
	Feet			*Feet*	
Youghiogheny: West Newton, Pa.	20	26	26	23.0	26
Walhonding: Walhonding, Ohio.	8	25	28	14.2	27
Tuscarawas:					
Newcomerstown, Ohio.	16	28	(1)	17.45	28
Coshocton, Ohio.	11	26	(1)	17.8	28
Muskingum: Lock No. 7, McConnellsville, Ohio.	22	27	29	24.1	27
Little Kanawha:					
Glenville, W. Va.	23	14	15	24.0	15
Creston, W. Va.	20	15	15	23.9	15
Olentangy: Delaware, Ohio.	9	26	27	10.5	27
Scioto:					
LaRue, Ohio.	11	25	28	13.55	27
Prospect, Ohio.	10	26	29	12.57	27
Circleville, Ohio.	14	26	29	18.62	28
Chillicothe, Ohio.	16	27	29	20.1	28
West Fork of White:					
Anderson, Ind.	8	15	16	8.4	16
		25	Mar. 1	11.4	27
Indianapolis, Ind.	12	27	27	12.6	27
Elliston, Ind.	18	27	Mar. 3	23.9	Mar. 1
Edwardsport, Ind.	12	27	Mar. 5	18.7	Mar. 2
East Fork of White: Seymour, Ind.	10	15	17	12.4	15, 16
		28	29	10.3	28
White:					
Petersburg, Ind.	16	Mar. 2	Mar. 6	18.6	Mar. 4
Hazelton, Ind.	16	Mar. 2	Mar. 7	19.3	Mar. 5
Wabash:					
Bluffton, Ind.	10	26	Mar. 1	12.9	26
Logansport, Ind.	17	27	27	17.8	27
Lafayette, Ind.	11	25	Mar. 4	25.5	27
Covington, Ind.	16	26	Mar. 5	28.8	29
Terre Haute, Ind.	14	26	Mar. 8	23.7	Mar. 1
Vincennes, Ind.	14	Mar. 3	Mar. 11	21.3	Mar. 5
Mount Carmel, Ill.	19	Mar. 4	Mar. 9	21.9	Mar. 7
New Harmony, Ind.	15	Mar. 6	Mar. 11	16.8	Mar. 8
Pigeon: Newport, Tenn.	6	4	4	10.8	4
French Broad:					
Oldtown, Tenn.	6	4	5	9.2	4
Dandridge, Tenn.	12	4	5	12.8	5
Asheville, N. C.	6	4	4	6.4	4
Little Tennessee: McGhee, Tenn.	18	5	5	21.5	5
Hiwassee: Charleston, Tenn.	22	5	5	27.0	5
Tennessee:					
Chattanooga, Tenn.	30	6	7	31.3	6
Bridgeport, Ala.	18	6	8	21.6	7
Widows Bar Lock, Ala.:					
Upper gage.	17	5	9	27.6	7
Lower gage.	26	6	9	30.3	7
Guntersville, Ala.	25	5	10	28.9	8
Florence, Ala.	18	----	----	17.9	9
Riverton Lock, Ala.	33	6	12	36.5	10
Savannah, Tenn.	39	----	----	35.2	10, 11
Ohio:					
Pittsburgh, Pa.	25	27	28	29.2	28
Dam No. 6, Beaver, Pa.	30	27	28	32.9	28
Dam No. 46, Owensboro, Ky.	41	22	24	41.9	23
Dam No. 47, Newburgh, Ind.	38	19	25	46.1	23
Evansville, Ind.	35	19	25	40.6	24
Dam No. 48, Cypress, Ind.	38	23	25	45.1	24
Dam No. 50, Fords Ferry, Ky.	34	25	26	35.6	25
PACIFIC SLOPE DRAINAGE					
San Joaquin Basin					
Kings: Piedra, Calif.	10	2	2	10.35	2
		22	22	12.40	22
Mokelumne: Bensons Ferry, Calif.	12	14	15	12.2	15
		18	18	12.5	18
		23	25	14.3	24
Sacramento Basin					
Sacramento:					
Red Bluff, Calif.	23	21	22	25.4	22
Knights Landing, Calif.	30	22	27	31.0	25

WEATHER OF THE ATLANTIC AND PACIFIC OCEANS

[The Marine Division, I. R. TANNEHILL, in charge]

NORTH ATLANTIC OCEAN, FEBRUARY 1936

By H. C. HUNTER

Atmospheric pressure.—Pressure averaged below normal over nearly the entire North Atlantic region, but around Iceland there was a considerable excess. The deficiency, however, was noteworthy over the eastern part of the ocean from near Ireland to the waters adjacent to northwestern Africa, and westward beyond midocean.

The average pressure at Horta, in the western Azores, was 29.84 inches, almost identical with the average for the preceding month. During the last 10 years there have been but two other months—January 1929 and March 1931—when pressure at Horta averaged as low as 29.84; and no other period of 2 consecutive months shows so low an average as these first 2 months of 1936. During the final week of February the pressure averaged greater than normal at Horta and also at Bermuda and Turks Island.

Of the four reports of force 12 wind so far received from the North Atlantic, only one was encountered to northward of latitude 38°. The lowest pressure reading of the month, 28.22 inches, early on the 9th, from the American steamship *Collamer*, occurred near the thirty-seventh parallel of latitude, about 600 miles west of Horta. It is not often that the lowest monthly pressure is encountered so far to the southward, unless it be connected with a hurricane of the West Indian region.

The highest pressure thus far reported, 30.69 inches, was observed on the British motorship *Wellfield*, during the forenoon of the 25th, near latitude 45° N., longitude 30° W.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure (sea level) at selected stations for the North Atlantic Ocean and its shores, February 1936*

Station	Average pressure	Departure	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Julianehaab, Greenland	29.66	----------	30.26	26	28.90	8
Reykjavik, Iceland	29.85	+0.31	30.45	28	28.99	6
Lerwick, Shetland Islands	29.70	−.02	30.34	10	28.96	2
Valencia, Ireland	29.59	−.31	30.25	25	28.73	18
Lisbon, Portugal	29.85	−.25	30.25	24	29.44	18
Madeira	29.93	−.14	30.35	24	29.60	12
Horta, Azores	29.84	−.31	30.57	25	28.95	9
Belle Isle, Newfoundland	29.71	−.04	30.56	25	28.78	1
Halifax, Nova Scotia	29.94	+.03	30.44	25	29.32	11
Nantucket	30.03	−.01	30.47	24	29.35	18
Hatteras	30.08	−.03	30.51	23	29.38	14
Bermuda	30.05	−.07	30.32	13, 24	29.71	11
Turks Island	30.03	−.05	30.23	25	29.94	10, 11
Key West	30.01	−.06	30.33	23	29.80	14
New Orleans	30.07	−.02	30.40	22	29.60	13

NOTE.—All data based on a. m. observations only, with departures compiled from best available normals related to time of observation, except Hatteras, Key West, Nantucket, and New Orleans, which are 24-hour corrected means.

Cyclones and gales.—Gales were comparatively numerous, especially from the 4th to the 18th. There were 9 instances when force 11 or force 12 was attained.

In the vicinity of the Grand Banks, whole gales were experienced on the 3d and 4th, one report even estimating force 11. The cyclone center moved from that vicinity to northeastward and northward, and ceased to have marked effect along the chief steamship routes.

An important LOW was just east of Cape Hatteras on the morning of the 7th, and advanced swiftly eastward, as a strong high-pressure area moved in behind it. Numerous gales were noted in the waters east of the Middle Atlantic States, the American steamship *F. Q. Barstow* encountering force 12. This LOW by the 9th had become one portion of a vast cyclonic area, a northern center being over Greenland, and a southern center near Horta. During the 9th and 10th another wind of force 12 was recorded and three vessels estimated the greatest force as 11. These strongest winds were met near the thirty-fifth or fortieth meridians, approximately in the latitude of the Azores.

The morning of the 10th found the chief and very intense center of the great LOW in about the longitude of Horta, but not far from the fiftieth parallel, held by high pressure near the Shetland Islands from advancing in the usual northeasterly course. Its strength soon decreased, as it moved southeastward toward northern Spain.

Charts IX, X, and XI indicate the conditions on the 7th, 9th, and 10th days of February, respectively.

About the 12th to 14th, low pressure was again experienced near the Azores, especially to the westward and northwestward; and there were two other instances of force 12 winds near midocean. At about the same time a storm central near the Carolina coast caused strong winds over a considerable area, including the northeast part of the Gulf of Mexico. One vessel in the Atlantic, about 400 miles east of Jacksonville, Fla., noted force 11.

On the morning of the 18th a LOW was central over the province of Quebec, with a well-marked southward extension located off the coast of the Middle Atlantic States. High winds in connection with this cyclonic system seem to have been the principal factor in the distress of the Greek freight steamer *Stefanos Costomenis*, which foundered late on the 18th, 400 miles off the Virginia Capes. The entire crew had been safely taken on board the American liner *City of Newport News*.

The last important storm over the western Atlantic during February was centered over the Gulf of Mexico on the 20th, and traveled toward the east-northeast and then the northeast, reaching the vicinity of Newfoundland by the 23d. Chart XII indicates the situation on the 22d.

Several instances of comparatively strong winds south of the Tropic of Cancer were reported. In the western Caribbean Sea the trades were intensified about the 8th, and in the north-central part, about the 23d. In the Gulf of Mexico a wind of force 7 was noted close to Vera Cruz on the 28th. On the 26th to 28th strong trades were encountered by the Italian motorship *Neptunia*, near the coast of northwestern Africa.

Fog.—While the Gulf of Mexico had distinctly less fog than there had been during January just preceding, yet the regions near the coast from the Carolinas to Newfoundland had a marked increase. Practically throughout this area there was more fog than February usually brings, the 5° square from 35° to 40° N., 70° to 75° W. reporting 9 days, the greatest number experienced by any one square, as far as now known. Here, and in the Grand Banks region, and thence eastward to about the thirtieth meridian, the second half of the month was more foggy than the first half.

Between the thirtieth meridian and the coasts of the continent of Europe and the British Isles, fog was no more frequent than during January, and nearly all the occurrences reported were during the first 12 days of February.

Coastal ice.—As during January, the heavy ice in most coastal waters from Virginia to Maine and beyond was a

great hindrance to navigation, but during the last few days of the month there was some improvement, most of this ice softening or breaking up.

Numerous steamships were damaged by ramming their way through ice, and a few were caught in heavy ice floes and carried aground.

OCEAN GALES AND STORMS, FEBRUARY 1936

Vessel	Voyage		Position at time of lowest barometer		Gale began February—	Time of lowest barometer February—	Gale ended February—	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Direction and highest force of wind	Shifts of wind near time of lowest barometer
	From—	To—	Latitude	Longitude									
NORTH ATLANTIC OCEAN			° ′	° ′				*Inches*					
Exporter, Am. S. S.	Casablanca	New York	35 49 N.	62 08 W.	1	Noon, 1	3	29.84	W	W, 7	WNW.	WNW, 10	W-WNW.
Steel Inventor, Am. S. S.	Swansea	Baltimore	47 18 N.	45 36 W.	4	9a, 3	5	29.37	W	W, 6	S	NW, 11	
Chickasaw City, Am. S. S.	Cristobal	Boston	12 00 N.	78 02 W.	3	4p, 3	4	29.75	NE	NE, 7	E	E, 8	
Exporter, Am. S. S.	Casablanca	New York	37 40 N.	70 14 W.	4	11p, 4	5	29.68	S	SW, 9	N	SW, 10	SW-Var-NW.
Jean Jadot, Belg. S. S.	New York	Antwerp	45 08 N.	41 49 W.	4	Mdt., 4	5	29.25	WNW.	W, 10	NNW.	WNW, 10	W-WNW.
Cardonia, Am. S. S.	Rotterdam	New Orleans	32 15 N.	30 45 W.	5	2p, 5	5	29.61	NW	NW, 10	N	NW, 10	NW-N.
American Importer, Am. S. S.	Liverpool	New York	[1]47 15 N.	42 07 W.	6	4a, 6	7	29.04	W	SW, 7	NW	NW, 10	SSW-W.
F. Q. Barstow, Am. S. S.	Baytown, Tex.	Providence	[1]35 16 N.	74 45 W.	6	10a, 7	7	29.32	NE	E, 6	NNE.	NW, 12	E-WNW-NW.
Borinquen, Am. S. S.	New York	San Juan	36 00 N.	71 40 W.	7	4p, 7	7	29.30	NE	SW, 7	NNW.	NNW, 10	S-SW-NNW.
Collamer, Am. S. S.	Havre	New York	37 15 N.	42 00 W.	8	1a, 9	10	28.22	WSW.	W, 11	NW	W, 12	W-NNW.
Maiden Creek, Am. S. S.	Glasgow	Mobile	35 20 N.	42 25 W.	8	do	9	28.96	WSW.	W, 11	NNW.	W, 11	WSW-W.
Louisiane, Fr. S. S.	Antwerp	do	35 10 N.	39 00 W.	8	3a, 9	10	29.13	WSW.	WSW, 10	NNW.	WNW, 11	WSW-NW.
West Tacook, Am. S. S.	London	Galveston	32 25 N.	36 35 W.	8	4a, 9	10	29.46	WSW.	WSW, 8	NW	NW, 9	WSW-W.
Imlay, Am. S. S.	New York	Corpus Christi	27 26 N.	94 41 W.	8	6a, 9	9	29.89	NW	NW, 9	N	NW, 9	WNW-NW.
American Shipper, Am. S. S.	do	Liverpool	50 20 N.	19 17 W.	8	2p, 9	9	28.86	E	ESE, 9	SSE.	ESE, 10	
Shickshinny, Am. S. S.	Antwerp	Wilmington, N. C.	41 17 N.	32 50 W.	6	do	11	28.57	WSW.	NNE, 10	SW	NW, 11	NE-NNE.
Helmstrath, Br. S. S.	Huelva	Philadelphia	36 16 N.	20 08 W.	9	4a, 10	10	29.29	SW	SW, 8	WSW.	SW, 9	SW-WSW.
San Antonio, Fr. S. S.	Havre	Cristobal	43 00 N.	16 00 W.	10	Noon, 10	10	28.73	SSW.	SW, 10	WSW.	SW, 10	SW-WSW.
Boston City, Br. S. S.	Halifax	Cardiff	51 21 N.	18 07 W.	8	7p, 10	10	28.55	E	E, 8	S	E, 10	E-S.
Shickshinny, Am. S. S.	Antwerp	Wilmington, N. C.	38 00 N.	41 50 W.	12	4a, 12	14	29.65	SW	SW, 8	NW	NW, 12	None.
Losada, Br. M. S.	Magallanes	London	24 32 N.	17 00 W.	11	5a, 12	13	29.66	W	W, 8	WNW.	W, 9	W-WNW.
Pawnee, Am. S. S.	Tampa	New Orleans	28 39 N.	87 38 W.	13	6a, 13	13	29.34	S	W, 10	W	W, 10	S-W-NNW.
El Estero, Am. S. S.	Norfolk	Houston	30 00 N.	77 24 W.	13	6p, 13	13	29.62	S	SSW, 8	SW	S, 10	S-SW.
Forbes Hauptman, Am. S. S.	do	Colon	29 48 N.	74 23 W.	13	11p, 13	14	29.73	E	SSW, 11	SSW.	SSW, 11	SSE-SW.
Standard, Am. S. S.	New York	Aruba	37 38 N.	73 10 W.	14	8a, 14	14	29.30	SE	SSW, 8	WNW.	W, 10	S-W.
Yaka, Am. S. S.	Manchester	Tampa	40 29 N.	31 02 W.	14	2p, 14	16	28.65	WSW.	WNW, 12	WSW.	WNW, 12	WSW-WNW
Japan Arrow, Am. S. S.	Boston	Beaumont	37 37 N.	70 45 W.	13	do	15	29.23	SE	WSW, 8	NW	SE, 10	SSW-W.
Helmstrath, Br. S. S.	Huelva	Philadelphia	34 45 N.	34 06 W.	14	4p, 14	15	29.67	W	WNW, 10	WNW.	WNW, 10	WNW-NW.
Syros, Am. S. S.	Rotterdam	Galveston	37 50 N.	26 30 W.	14	2a, 15	16	29.20	S	W, 10	W	W, 10	None.
Afoundria, Am. S. S.	do	Tampa	42 30 N.	25 15 W.	14	9a, 15	16	28.67	SW	WSW, 7	W	WNW, 10	WSW-WNW.
West Harshaw, Am. S. S.	Manchester	New Orleans	38 19 N.	37 16 W.	16	8a, 16	16	29.14	SW	SW, 9	NNW.	WSW, 10	SW-NNW.
Mahanada, Br. S. S.	Gibraltar	Boston	36 10 N.	27 40 W.	16	2a, 17	17	29.09	SW	W, 7	WNW.	WSW, 10	WSW-NW.
Losada, Br. M. S.	Magallanes	London	43 16 N.	9 37 W.	15	5p, 17	18	29.02	WSW.	SSE, 8	SSW.	SSE, 9	SSE-SSW.
Quaker City, Am. S. S.	New York	Cork	42 00 N.	60 35 W.	18	Mdt., 18	19	29.45	SSW.	SSW, 10	W	SW, 10	W-SW.
Otho, Am. S. S.	Freetown	Philadelphia	32 55 N.	62 36 W.	23	6p, 22	24	29.74	WNW.	SSW, 7	NW	NW, 9	SSW-WNW.
Standard, Am. S. S.	Aruba	New York	12 54 N.	70 24 W.	24	7p, 22	25	29.97	NNE.	E, 4	ENE.	NE, 8	
Greystoke Castle, Br. M. S.	Penang via Cape of Good Hope.	do	26 23 N.	63 41 W.	22	10p, 22	24	29.92	SW	NW, 8	N	NW, 8	SW-NW-N.
Breedyk, Du. S. S.	Rotterdam	Tampa	32 56 N.	51 48 W.	23	3p, 23	24	29.79	S	SSW, 8	NNW.	WNW, 8	SSW-NNW.
Neptunia, Ital. M. S.	Recife	Gibraltar	9 00 N.	25 35 W.	26	10a, 25	[2]28	[2]29.80	NE	NE, 5	NE	NE, 8	None.
Salawati, Du. M. S.	Capetown	Boston	25 40 N.	46 06 W.	27	4p, 27	28	29.86	NNW.	NNW, 10	NNE.	NNW, 10	NNW-N.
Narbo, Am. S. S.	Greenock	Port Neches	[1]51 20 N.	7 49 W.	28	Mdt., 27	[3]1	29.20	NNW.	NW, 6	N	N, 10	W-NW.
Mexique, Fr. S. S.	New Orleans	Vera Cruz	[1]20 00 N.	95 37 W.	28	do	28	29.98	W	W, 7	NNW.	NW, 7	W-NW.
NORTH PACIFIC OCEAN													
Ogura Maru, Jap. M. S.	Yokohama	Los Angeles	36 18 N.	149 30 E.	1	10a, 2	2	29.26	NW	W, 7	WNW.	NW, 8	WNW-W.
Diamond Head, Am. S. S.	Portland, Oreg.	Port Allen, T. H.	28 08 N.	153 03 W.	[4]31	6p, 2	2	29.13	E	SE, 4	S	SE, 10	SE-S.
Tai Ping, Yang, Pan. MS.	Yokohama	San Francisco	41 42 N.	162 00 E.	1	10a, 3	1	29.13	WNW.	WSW, 5	WNW.	WNW, 9	
Tatsuno Maru, Jap. S. S.	do	Los Angeles	39 42 N.	157 17 E.	[4]31	4a, 3	4	[2]29.11	NW	WNW, 6	W	WNW, 10	NW-W.
Chinese Prince, Br. M. S.	Los Angeles	Kobe	29 56 N.	161 06 E.	2	Mdt, 2	3	29.70	WSW.	WSW, 10	WNW.	WSW, 10	WSW-WNW.
Peter Maersk, Dan. M. S.	do	Yokohama	34 18 N.	152 00 W.	3	9p, 4	4	29.57	E	E, 7	SE	E, 8	E-SE.
Biyo Maru, Jap. S. S.	Miike	Seattle	31 28 N.	131 51 E.	4	5a, 4	5	29.89				NNW, 9	W-NNW.
Corneville, Nor. M. S.	San Francisco	Yokohama	32 .. N.	150 .. E.	4	2p, 5	6	29.13	SSW.	W, 12	NNW.	W, 12	None.
Chinese Prince, Br. M. S.	Los Angeles	Kobe	[1]30 37 N.	150 10 E.	5	6a, 5	6	29.40	SSW.	SSW, 9	NW	W, 12	SSW-W.
Pres. Hoover, Am. S. S.	Honolulu	Yokohama	29 49 N.	153 10 E.	5	2p, 5	6	29.45	SSW.	W, 9	NW	WNW, 11	S-W.
Peter Maersk, Dan. M. S.	Los Angeles	do	34 38 N.	160 52 W.	6	6a, 6	7	29.37	WNW.	NW, 7	NW	NW, 9	Steady.
Athelprincess, Br. M. S.	Nagaski	Esteros Bay	34 44 N.	167 51 E.	6	Noon, 6	6	29.38	SSE.	SW, 9	W	S, 10	S-SW.
Pres. Polk, Am. S. S.	San Francisco	Honolulu	23 54 N.	153 30 W.	6	2p, 6	7	29.51	SW	W, 8	WNW.	WNW, 8	None.
Paul Shoup, Am. S. S.	do	do	25 00 N.	150 20 W.	6	2a, 7	8	29.53		W, 8		W, 8	
Manoa, Am. S. S.	do	do	31 14 N.	140 11 W.	10	2a, 9	10	29.43	WSW.	S, 5	WSW.	W, 8	S-W.
Empress of Japan, Br. S. S.	Victoria	do	38 27 N.	141 02 W.	10	4p, 10	11	29.14	W	SE, 3	WNW.	WNW, 8	SE-W.
Spirila, Br. S. S.	Los Angeles	Kobe	31 01 N.	148 20 E.	11	7p, 11	12	29.72	W	W, 6	NW	W, 10	None.
Peter Maersk, Dan. M. S.	do	Yokohama	34 49 N.	168 45 E.	12	4p, 12	13	29.36	S	SSW, 7	WNW.	W, 10	SSW-SW.
Koyo Maru, Jap. S. S.	Yokohama	Port San Luis	38 21 N.	175 15 W.	13	2a, 13	13	[2]29.05	WSW.	WSW, 7	W	W, 10	WSW-W.
Peter Maersk, Dan. M. S.	Los Angeles	Yokohama	34 37 N.	156 33 E.	15	Noon, 15	16	29.54	S	SSW, 7	NNW.	NW, 11	SSW-W.
Pres. Jefferson, Am. S. S.	Seattle	do	[1]49 52 N.	173 30 E.	20	8p, 22	22	29.05	SE	S, 6	S	SE, 9	SSE-SSW.
Koyo Maru, Jap. S. S.	Yokohama	Port San Luis	38 08 N.	136 21 W.	20	10p, 20	21	[2]29.06	SW	SW, 7	WSW.	W, 8	SW-W.
Illinois, Am. S. S.	Manila	San Francisco	47 18 N.	163 36 W.	23	1p, 24	24	29.41	ESE	SW, 6	SE	ESE, 9	
Golden Mountain, Am. S. S.	Tandoc	do	31 57 N.	147 19 E.	23	5a, 24	24	29.02	S	WNW, 12	N	WNW, 12	W-NW.
Pennsylvania, Am. S. S.	Manila	do	33 06 N.	148 06 E.	23	3a, 24	24	28.76	SW	SW, 11	NNW.	W, 12	SW-WNW.
Shelton, Am. S. S.	Tabaco	Los Angeles	31 30 N.	149 10 E.	24	4a, 24	24	29.35	SW	SW, 8	NW	WNW, 11	SW-WNW.
Skramstad, Nor. M. S.	Manila	do	28 42 N.	158 50 E.	24	10a, 24	25	[2]29.42	SSE.	SSW, 8	NW	W, 9	S-SSW-W.
Meigs, U. S. A. T.	do	San Francisco	36 50 N.	170 32 E.	24	6a, 25	26	28.43	SE	ESE, 5	W	WNW, 11	ESE-WSW.
Golden Hind, Am. S. S.	Otaru	do	41 38 N.	169 18 W.	24	4a, 26	27	28.54	SSE.	SE, 5	WSW.	SW, 10	SE-SW.

[1] Position approximate. [2] Barometer uncorrected. [3] March. [4] January.

OCEAN GALES AND STORMS, FEBRUARY 1936—Continued

Vessel	Voyage		Position at time of lowest barometer		Gale began February—	Time of lowest barometer February—	Gale ended February—	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Direction and highest force of wind	Shifts of wind near time of lowest barometer
	From—	To—	Latitude	Longitude									
NORTH PACIFIC OCEAN—Continued			° ′	° ′				*Inches*					
Shelton, Am. S. S.	Tabaco	Los Angeles	33 30 N.	153 42 E.	25	5p, 25	26	29.62	W	W, 8	NW	NW, 9	WSW-W.
Golden Mountain, Am. S. S.	Tandoc	San Francisco	33 12 N.	152 41 E.	25	4p, 25	26	29.62	SW	NW, 7	N	NW, 9	None.
Empress of Asia, Br. S. S.	Victoria	Yokohama	52 06 N.	167 35 W.	26	4p, 26	27	28.98	ENE	ENE, 7	N	NE, 8	ENE-NE.
Shelton, Am. S. S.	Tabaco	Los Angeles	33 38 N.	159 40 E.	27	4p, 27	28	28.58	SE	SW, 12	NW	WSW, 12	SW-NW.
Golden Mountain, Am. S. S.	Tandoc	San Francisco	34 44 N.	160 36 E.	27	6p, 27	28	28.64	S	S, 10	NW	NW, 12	SE-S-NW.
Pennsylvania, Am. S. S.	Manila	do	36 36 N.	162 24 E.	27	do	28	29.27	ENE	ENE	N	NNE, 9	ENE-NNE.
Meigs, U. S. A. T.	do	do	36 52 N.	166 43 W.	27	Noon, 28	28	29.10	SSE	SSW, 8	WSW	SSW, 10	SSE-SSW.
SOUTH PACIFIC OCEAN													
Maunganui, Br. S. S.	Rarotonga	Wellington, N. Z.	40 24 S.	177 05 E.	2	4p, 2	3	28.73	N	WSW, 2	S	SSW, 12	N-WSW-SSW.

NORTH PACIFIC OCEAN, FEBRUARY 1936

By Willis E. Hurd

Atmospheric pressure.—The major average-pressure feature over the North Pacific Ocean in February 1936 was a great depression which dominated all the northern part of the ocean except extreme northeastern waters, and in middle longitudes extended well into the equatorial region. The lowest average pressure recorded for the month was 29.58 inches, at Dutch Harbor. This was practically normal for February. The center of the LOW, however, was somewhat to the southwestward. The extent of the depression is well indicated by the fact that at Midway Island and Honolulu the average barometers were 0.13 and 0.15 inch, respectively, below the normal for the month. At Honolulu the barometer fell to 29.34 inches on the 3d, which is, by almost two-tenths of an inch, the record low pressure for that station.

In extreme eastern waters of the Pacific, abnormal pressure conditions prevailed from the Alaskan Peninsula southeastward to southern California, as shown by the averages at Kokiak and Juneau, which were much above normal, and at Tatoosh Island and San Francisco, which were considerably below.

Over the southeastern and southwestern parts of the ocean, pressures were practically normal.

The high-pressure systems, on the average, this month were confined to the extreme northeastern Pacific and to the waters east of China.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level, North Pacific Ocean, February 1936, at selected stations*

Stations	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Point Barrow	30.54	+0.42	31.10	4	30.02	29
Dutch Harbor	29.58	−.02	30.28	1	28.90	15
St. Paul	29.68	+.03	30.32	1	29.04	15
Kodiak	29.85	+.23	30.38	1	28.76	29
Juneau	30.06	+.14	30.46	6	29.21	29
Tatoosh Island	29.88	−.12	30.47	29	29.10	21
San Francisco	29.98	−.12	30.45	26	29.53	12
Mazatlan	29.93	.00	30.04	9	29.84	3, 4
Honolulu	29.90	−.15	30.08	11	29.34	3
Midway Island	29.86	−.13	30.10	9, 10	29.52	22
Guam	29.92	+.01	30.02	12	29.84	21
Manila	29.89	.00	29.96	(1)	29.80	28
Hong Kong	29.97	--------	30.28	11	29.67	25
Naha	30.01	−.04	30.26	12	29.68	25
Chichishima	29.96	−.02	30.18	3	29.76	20
Nemuro	29.86	--------	30.24	7	29.44	18

[1] On seven dates.

NOTE.—Data based on 1 daily observation only, except those for Juneau, Tatoosh Island, San Francisco, and Honolulu, which are based on 2 observations. Departures are computed from best available normals related to time of observation.

Cyclones and gales.—The meteorological conditions observed over the North Pacific were of unusual interest. In higher latitudes, although the Aleutian disturbance was prevalent throughout March, the degree of storminess between 40° N. and the Aleutian Islands and Alaska was comparatively slight. Practically all the gales reported along the northern routes occurred between the meridians of 180° and 160° W. on the 24th to 27th, and were mostly of forces 8 to 9.

The region most affected by storminess was that of the middle latitudes, roughly between 25° and 40° N. Into the western part of this region moved the most intense cyclones of the month; the central part was invaded to unusually low latitudes by extensions of the fluctuating Aleutian cyclone; and the eastern area was the scene of the abnormal cyclonic activity which on the 3d caused the lowest pressure ever known over the eastern Hawaiian Islands.

This storm, which may be referred to as the Hawaiian cyclone, was centered to the northeast of the islands on the 1st, moving west, with a southward inclination. It was already of great depth for its location, and by the 2d had acquired considerable wind intensity, as indicated by the report of the American steamer *Diamond Head*, which experienced a gale of force 10 from the southeast. The ship's lowest barometer for the day was 29.13 inches, read near 28° N., 153° W. On the 3d the center was close to the north of Honolulu. Thereafter the storm moved first to the northeast and then to the northwest but from the 7th to 10th remained practically stationary about midway along the California to Hawaii routes. On the 11th it moved rapidly northeast and entered the Washington-Oregon coast on the 12th. Throughout its course it was of unusual depth for a cyclone in this region. Fresh local gales attended most of its course from the 1st to 12th, except on the 2d, when the heavier gale was reported.

An important cyclone of the month was that which lay as a depression over central Japan on February 3. This disturbance moved rapidly seaward, and had gathered great energy by the 4th, on which date the American steamer *President Garfield*, near 35° N., 145° E., experienced a south-southwest gale of hurricane force, barometer 29.30. On the 5th the Norwegian motorship *Corneville* and the British motorship *Chinese Prince* were heavily involved near 30°–32° N., 150° E., both reporting hurricane velocities. In a special report of the storm from the *Chinese Prince*, Capt. W. Finch, master, Leslie G. Taylor, third officer and observer, the violence of the storm was stressed, and it was stated that on the morning of the

5th the waves piling in with the westerly wind squalls were "estimated to have a height of 50 to 60 feet"; another point of interest was that "the most noticeable characteristic of the cyclone was the absence of rain; what rain squalls were experienced were short in duration—possibly lasting not more than 30 seconds."

On the 6th the cyclone expanded and lost energy as it moved into higher latitudes.

During the middle third of February the major part of the ocean was dominated by cyclonic conditions. The severest gale of this period was reported from the Danish motorship *Peter Maersk* on the 15th, near 35° N., 157° E., barometer 29.54. Gales of lesser force (8–10), but accompanied by lower pressures, occurred near midocean on the 12th to 14th. There were, however, fewer gales reported than might have been expected as a result of this long-continued disturbance.

On February 22 a LOW appeared south of Japan. At this time the highest wind force reported in connection with it was 8. With eastward advance of the cyclone, however, it gathered energy; and on the 24th, in 32°–33° N., 147°–148° E., the American steamers *Golden Mountain* and *Pennsylvania* were experiencing hurricane winds, lowest barometer on the *Pennsylvania*, 28.76. Close by these ships, the American steamer *Shelton* encountered winds of force 11 from west-northwest. This steamer, during the early part of her passage from Tabaco to Los Angeles, had much tempestuous weather, culminating in a further westerly gale, of force 12, on the 27th near 34° N., 160° E. Upon this occasion, while the seas were moderate, the air was so filled with flying spume that visibility was restricted to 50 feet. The barometer was oscillating so violently that accurate readings could not be obtained.

In connection with the heavily disturbed weather of the 24th to 27th in east longitudes, the U. S. A. T. *Meigs*, on the 25th, reported a wind of force 11, and the lowest pressure reading of the month, 28.43, both near 37° N., 171° E.

By February 29 the weather had moderated over all heretofore stormy parts of the ocean, with the center of the principal LOW lying over the Gulf of Alaska.

Tehuantepecers.—In the Gulf of Tehuantepec northers of force 7 occurred on the 1st and 22d.

Fog.—More fog was observed along the eastern half of the northern routes than during any previous month since September 1935, ships in some 5-degree squares south of the eastern Aleutians reporting it on 3 days. In the region 24°–45° N., 125°–140° W., it was reported on 10 days. For American coastal waters, there were 2 days with fog observations off Washington-Oregon; 8 days off California; 6 off lower California; and 2 south of Costa Rica.

Waterspout and static.—Observing Officer Taylor on the British motorship *Chinese Prince*, reported a waterspout in connection with a heavy line squall in 24°42′ N., 127°08′ E., on the 22d. According to the wireless operator on the ship, "previous to the waterspout atmospherics were very bad, but immediately after vessel had passed the phenomenon, radio reception was almost perfect."

CLIMATOLOGICAL TABLES

CONDENSED CLIMATOLOGICAL SUMMARY

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by sections, February 1936

[For description of tables and charts, see REVIEW, January, p. 29]

(Compiled by Annie E. Small, by official authority, U. S. Weather Bureau)

Section	Temperature								Precipitation					
			Monthly extremes								Greatest monthly		Least monthly	
	Section average	Departure from the normal	Station	Highest	Date	Station	Lowest	Date	Section average	Departure from the normal	Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	46.5	−2.3	4 Stations	80	[1] 24	St. Bernard	−7	1	7.29	+2.08	Clayton	12.51	Riverton	2.86
Arizona	47.0	−1.2	Gould's Ranch	87	29	Fort Valley	−5	4	1.81	+.56	Junipine	8.48	2 stations	T
Arkansas	36.5	−7.0	Magnolia	89	[1] 26	Lead Hill	−15	18	1.70	−1.59	St. Francis	3.73	Index	.77
California	46.5	−1.7	Mecca	93	28	2 stations	−18	3	9.51	+5.17	Bowman Dam	29.97	Cow Creek	.05
Colorado	25.1	−2.1	Holly	79	23	Hayden	−38	8	1.52	+.55	Crested Butte	8.13	2 stations	.00
Florida	58.0	−2.5	Belle Glade	87	5	Quincy	18	1	6.71	+3.57	Punta Gorda	12.11	Miami	2.31
Georgia	45.5	−3.0	Fargo	82	26	Tallapoosa	−8	1	6.50	+1.60	Columbus	11.68	Greensboro	2.95
Idaho	20.7	−7.3	Grand View	61	22	Lake	−37	8	2.84	+1.13	Roland	9.19	Glenns Ferry	.08
Illinois	19.2	−10.0	Harrisburg	73	25	Freeport	−24	5	1.87	−.27	Casey	3.69	Chester	.97
Indiana	22.5	−7.8	Shoals	73	25	2 stations	−19	[1] 6	2.60	−.19	Huntington	4.92	Hobart	1.23
Iowa	6.0	−16.3	Keokuk	71	24	Sibley	−35	16	1.33	+.24	Sanborn	2.83	Riverton	.39
Kansas	22.2	−10.7	2 stations	84	[1] 23	5 stations	−23	8	.23	−.77	Wagstaff	1.76	15 stations	T
Kentucky	32.1	−4.8	Farmers	79	26	Farmers	−14	1	1.95	−1.43	Middlesboro	3.29	Ford	1.01
Louisiana	50.2	−3.5	Dodson	85	25	2 stations	12	[1] 9	4.15	−.43	Paradis	8.07	Shreveport	1.40
Maryland-Delaware	26.7	−7.2	Solomons, Md.	70	25	do	−20	8	3.82	+.87	Millsboro, Del.	5.85	Keedysville, Md.	2.54
Michigan	10.8	−9.6	Midland	55	25	3 stations	−35	10	1.76	+.11	Whitefish Point	3.55	Sidnaw	.55
Minnesota	−5.5	−17.8	Zumbrota	44	23	Ada	−53	15	1.41	+.67	Albert Lea	3.30	Meadowlands	.45
Mississippi	44.5	−4.8	Yazoo City	84	24	2 stations	−3	1	4.79	−.11	Meridian	10.88	University	2.15
Missouri	23.2	−9.7	Garber	78	24	Bethany	−25	5	1.50	−.56	Philadelphia	4.45	Lucerne	.25
Montana	−.1	−22.4	Wyola	58	22	2 stations	−59	15	1.32	+.63	Heron	7.01	Ekalaka	.16
Nebraska	8.9	−17.3	McCook	77	22	Nenzel (near)	−43	6	.81	−.10	Hartington	2.42	Alma	.05
Nevada	35.2	+1.2	Longandale	78	29	San Jacinto	−24	8	2.47	+1.42	Marlette Lake	18.23	Golconda	.40
New England	17.4	−5.1	Brattleboro, Vt.	52	27	Bloomfield N. H.	−29	9	2.67	−.48	Portland, Me.	5.30	Bethlehem, N. H.	1.05
New Jersey	24.4	−6.3	Pleasantville	66	25	Canoe Brook	−17	20	3.10	−.51	Pleasantville	5.64	Canoe Brook	1.12
New Mexico	37.0	−.4	Carlsbad	84	21	Selsor Ranch	−23	4	.70	−.01	Aspen Grove Ranch	4.73	27 stations	.00
New York	15.6	−6.5	3 stations	56	[1] 25	Stillwater Reservoir	−29	22	2.18	−.50	Franklinville	5.18	Letchworth Park	.49
North Carolina	38.5	−4.1	2 stations	80	[1] 25	Boone	−7	8	4.72	+.66	Andrews	7.33	Marhsall	2.81
North Dakota	−12.9	−23.6	New England	43	29	Parshall	−60	15	.70	+.23	2 stations	1.58	Marmarth	.12
Ohio	22.7	−6.5	2 stations	75	26	McArthur	−20	1	2.55	−.03	New Carlisle	4.48	Lock No. 23	1.18
Oklahoma	33.7	−7.2	do	86	[1] 23	Hooker	−9	8	.42	−.91	Poteau	1.59	7 stations	.00
Oregon	30.8	−4.5	Powers	74	29	Meacham	−33	8	3.63	+.52	Haskins Dam	12.81	Kinzua	.41
Pennsylvania	21.5	−6.6	Waynesburg	69	26	Brookville	−27	20	2.33	−.53	Philadelphia Navy Yard.	6.00	Clearfield	.50
South Carolina	43.5	−3.9	2 stations	80	25	3 stations	0	1	4.89	+.62	Greenwood	6.99	Orangeburg	3.31
South Dakota	−3.8	−22.3	do	58	[1] 22	McIntosh	−58	17	.69	+.13	Menno	1.55	Eureka	.10
Tennessee	36.0	−5.1	Moscow	78	25	Greenville	−8	1	3.10	−1.25	Elkmont	6.71	Newbern	.93
Texas	46.1	−5.2	Bishop	95	13	Follett	−10	8	.73	−1.05	Orange	4.80	24 stations	.00
Utah	31.3	+1.2	St. George	73	29	Lewiston	−24	8	2.90	+1.64	Silver Lake	15.70	Emery	.19
Virginia	32.1	−4.9	Clarksville	79	[1] 25	2 stations	−14	8	3.86	+.74	Tappahannock	5.68	Dale Enterprise	2.17
Washington	22.5	−12.1	Wahluke	66	29	do	−34	[1] 9	4.41	+.44	Snoqualmie Pass	18.88	Ephrata	.27
West Virginia	28.4	−4.7	Robertsburg	80	26	Ryan	−25	1	2.61	−.50	Pickens	4.94	Dam 26 O. R.	.90
Wisconsin	2.8	−14.0	Rhinelander	54	25	Cumberland	−52	16	1.57	+.40	Downing	2.94	Hatfield	.65
Wyoming	12.1	−10.1	Pine Bluffs	69	22	2 stations	−48	8	1.54	+.76	Moose	8.68	Archer	.17
Alaska [January]	7.5	+4.9	Tree Point	55	[1] 24	Fort Yukon	−61	4	1.56	−.41	Cordova	18.14	Tanana	.00
Hawaii	69.6	+1.1	4 stations	88	[1] 2	Kanalohuluhulu	38	[1] 9	5.30	−1.04	Kawainui (upper)	25.47	Ka Lae	.06
Puerto Rico	72.8	−.1	Coloso	92	13	Guineo Reservoir	40	1	1.62	−1.30	Rio Grande (La Mina).	7.12	Coamo	.00

[1] Other dates also.

TABLE 1.—*Climatological data for Weather Bureau stations, February 1936*

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. +2 mean min. +2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0–10	In.	In.
New England							20.5	−4.9										70	2.95	−0.5										7.5		
Eastport	76	67	85	29.88	29.97	.....	19.2	−2.3	44	18	27	−4	7	12	33	17	11	72	1.73	−1.8	11	8,986	w.	32	nw.	2	11	7	11	5.4	7.5	2.1
Greenville, Maine	1,070	6	40	28.76	29.99	.....	10.1	.....	35	18	19	−17	7	2	33	.....	.....	.....	2.88	.....	12	5,690	nw.	26	.....	2	13	6	10	.....	20.0	T
Portland, Maine	103	82	117	29.90	30.03	+.01	19.9	−3.9	43	26	28	−1	1	12	25	17	9	65	5.30	+1.1	8	6,144	w.	27	nw.	2	16	5	8	4.0	29.1	10.0
Concord	289	60	.....	29.73	30.06	+.02	17.6	−5.2	44	26	27	−16	20	8	40	.....	.....	.....	2.82	−.2	10	.....	nw.	.....	.....	.....	10	10	9	.....	28.8	.0
Burlington	403	11	48	29.59	30.06	+.03	13.6	−5.8	43	25	22	−9	22	5	31	.....	.....	.....	1.48	−.2	11	7,089	s.	43	s.	24	6	7	16	6.5	16.3	7.2
Northfield	876	12	60	29.04	30.04	.00	11.6	−4.8	40	26	23	−16	22	0	37	10	7	85	1.31	−1.0	10	5,477	s.	24	s.	24	6	8	15	6.6	13.6	22.0
Boston [1]	29	31	50	.....	30.04	.00	22.8	−6.0	46	26	30	4	19	16	34	.....	.....	.....	3.66	+.2	9	8,029	w.	.....	.....	.....	13	4	12	.....	12.6	.0
Nantucket	12	14	90	30.02	30.03	−.01	26.8	−3.9	49	26	33	7	19	21	30	24	20	77	2.71	−.8	11	10,302	w.	49	e.	14	9	6	14	6.1	4.1	.0
Block Island	26	11	46	30.02	30.05	−.01	25.2	−5.2	45	27	30	7	19	20	29	24	19	74	3.43	−.4	12	12,250	w.	49	nw.	18	10	7	12	6.0	8.8	T
Providence	160	215	251	29.87	30.06	+.01	23.4	−5.6	49	26	31	4	19	16	33	21	13	65	3.77	.0	9	8,285	nw.	43	nw.	18	14	4	11	5.1	7.9	1.0
Hartford	159	70	104	.....	30.09	+.03	21.8	−5.4	46	26	29	−3	20	14	31	.....	.....	.....	3.21	−.8	10	5,354	n.	26	nw.	18	13	4	12	.....	15.3	9.5
New Haven	106	74	153	29.97	30.09	+.02	23.7	−5.3	48	26	31	1	19	17	32	20	13	64	3.05	−1.1	9	6,256	n.	35	n.	14	10	6	13	5.7	9.3	1.8
Middle Atlantic States							28.0	−5.4										70	3.14	−0.2										6.3		
Albany	97	97	112	29.99	30.10	+.03	18.3	−5.8	46	25	28	−12	20	8	33	16	10	70	1.92	−.6	14	4,922	s.	26	s.	24	10	8	11	5.5	11.2	T
Binghamton	871	57	79	29.11	30.09	+.01	18.1	−5.9	56	25	29	−13	20	7	40	.....	.....	.....	1.24	−1.1	9	4,989	w.	23	w.	27	5	5	19	7.3	8.2	1.0
New York	314	415	454	29.74	30.09	+.01	26.6	−4.7	52	26	34	2	19	20	33	23	14	60	2.41	−1.6	12	9,625	nw.	46	nw.	27	9	6	14	6.2	6.3	1.0
Harrisburg	374	94	104	29.69	30.11	+.02	24.1	−6.1	53	25	32	2	19	17	31	21	13	65	3.32	+.3	10	5,103	w.	27	nw.	18	8	8	13	6.3	10.6	1.5
Philadelphia	114	174	367	29.99	30.12	+.02	27.6	−6.3	57	25	34	4	19	21	29	24	16	64	3.46	.0	9	8,151	w.	29	n.	7	8	8	13	6.0	9.2	.0
Reading	323	283	306	29.76	30.13	.....	25.1	−3.7	55	25	32	2	19	18	34	22	15	67	2.79	−.8	10	7,555	nw.	41	e.	14	7	10	12	6.3	13.8	1.5
Scranton	805	72	104	29.19	30.10	+.02	21.5	−5.8	55	25	30	−3	19	13	39	18	11	65	1.31	−1.8	9	4,706	sw.	21	nw.	18	8	11	10	5.9	9.5	T
Atlantic City	52	37	172	30.04	30.10	−.01	28.8	−4.8	63	25	36	6	19	22	29	26	21	73	4.71	+1.2	11	10,831	w.	50	ne.	14	10	1	18	6.3	8.5	.0
Sandy Hook	22	10	57	30.07	30.09	.....	24.8	.....	48	25	30	2	19	19	29	23	19	78	2.60	−1.3	11	10,582	w.	41	ne.	14	10	4	15	5.8	6.1	.3
Trenton	190	88	106	29.90	30.12	.....	24.8	−3.9	51	25	32	2	19	18	31	22	17	73	2.20	−1.2	9	6,530	w.	26	nw.	18	9	7	13	5.9	9.1	T
Baltimore	123	100	215	29.99	30.13	+.02	29.7	−3.7	65	25	37	9	19	23	36	26	18	65	3.75	+.3	11	7,003	sw.	31	ne.	14	7	6	16	6.1	14.6	.0
Washington	112	62	85	29.99	30.12	+.01	29.6	−3.7	64	25	38	3	8	22	29	25	18	66	3.83	+.5	10	4,925	nw.	24	nw.	18	8	5	16	6.2	18.5	.0
Cape Henry	18	8	54	30.07	30.09	.....	35.4	−3.8	74	25	42	10	1	28	38	32	29	81	4.80	+1.5	13	8,839	n.	49	n.	18	7	8	14	6.7	17.2	.0
Lynchburg	686	5	.....	29.35	30.12	+.01	34.6	−3.7	75	25	46	0	8	23	37	.....	.....	.....	3.99	+.7	10	.....	sw.	.....	.....	.....	1	21	7	.....	10.4	.0
Norfolk	91	80	125	30.01	30.11	.00	37.0	−3.7	77	26	45	10	1	29	36	33	28	76	4.16	+.8	13	6,800	n.	35	n.	7	6	6	17	7.2	13.2	.0
Richmond	144	11	52	29.96	30.13	+.02	34.6	−5.0	76	25	44	6	8	26	33	30	25	74	3.92	+.6	10	5,582	ne.	24	n.	14	6	12	11	6.4	13.3	.0
Wytheville	2,304	49	55	.....	30.10	−.02	31.9	−3.2	70	26	42	−1	8	22	35	.....	.....	76	2.95	−.1	12	5,435	w.	30	w.	27	7	14	8	.....	8.6	.0
South Atlantic States							44.2	−3.7										75	4.51	+0.7										5.9		
Asheville	2,253	89	104	27.68	30.13	.00	36.6	−1.9	73	26	47	7	11	26	41	31	25	71	3.78	+.5	13	6,457	nw.	32	nw.	18	9	10	10	5.6	10.5	.0
Charlotte	779	63	86	29.25	30.11	−.01	40.3	−3.6	76	25	49	11	1	32	29	35	30	70	5.25	+1.0	11	5,534	ne.	26	ne.	6	9	6	14	5.9	6.7	.0
Greensboro	886	6	56	29.12	30.11	.....	35.2	.....	74	25	45	−4	1	25	37	30	26	77	3.98	.....	13	5,853	sw.	27	ne.	6	7	10	12	6.0	9.8	.0
Hatteras	11	5	50	30.07	30.08	−.03	41.2	−6.2	63	4	47	19	1	35	26	39	37	87	4.49	+.3	13	10,600	n.	51	nw.	7	10	4	15	6.3	1.5	.0
Raleigh	376	103	146	29.68	30.10	−.01	39.7	−3.5	78	25	49	14	1	31	33	35	30	74	5.38	+1.3	12	6,432	sw.	31	nw.	18	9	10	10	5.8	10.1	.0
Wilmington	72	73	107	30.03	30.11	−.01	44.6	−3.3	74	26	54	14	1	36	29	39	35	75	5.05	+1.7	12	6,840	n.	35	nw.	18	11	4	14	5.9	3.7	.0
Charleston	48	11	92	30.05	30.10	−.02	48.4	−4.0	75	25	56	24	1	41	26	43	39	76	3.45	+.4	14	7,895	ne.	30	w.	13	10	2	17	6.2	.0	.0
Columbia, S. C	347	67	73	29.72	30.11	.00	44.7	−3.5	76	25	54	16	1	36	28	39	32	68	4.30	+.4	11	4,883	ne.	21	s.	4	11	3	15	5.6	1.1	.0
Greenville, S. C	1,039	139	.....	.....	.....	.....	40.0	−3.3	74	26	49	12	1	31	26	.....	.....	.....	4.19	−1.2	11	.....	ne.	.....	.....	.....	12	6	11	.....	3.9	.0
Augusta	182	62	77	29.89	30.09	−.03	45.9	−4.0	76	26	55	17	1	36	33	40	34	69	4.91	+.7	11	4,388	nw.	21	nw.	13	10	4	15	5.9	T	.0
Savannah	65	73	152	30.02	30.09	−.03	50.8	−3.2	77	25	60	23	1	42	27	44	41	79	3.74	+.5	13	7,732	n.	46	sw.	13	11	3	15	6.0	.0	.0
Jacksonville	43	86	110	30.05	30.10	−.02	53.7	−4.3	77	25	63	25	1	45	29	48	45	81	5.11	+2.0	13	6,062	ne.	35	sw.	13	10	5	14	5.9	.0	.0
Florida Peninsula							66.6	+0.1										82	5.06	+3.1										5.7		
Key West	22	10	64	29.99	30.01	−.06	70.6	+.1	82	9	76	54	1	65	16	66	64	84	5.45	+4.1	11	7,522	se.	32	nw.	21	9	11	9	5.3	.0	.0
Miami	25	124	168	30.02	30.05	−.05	68.2	+1.1	82	9	74	42	1	62	24	63	60	80	2.31	+.4	14	8,129	s.	34	sw.	21	8	6	15	6.5	.0	.0
Tampa	35	88	197	30.02	30.06	−.04	61.0	−.9	78	27	70	32	1	52	30	55	52	81	7.43	+4.8	12	8,630	ne.	38	n.	15	10	9	10	5.2	.0	.0
Titusville	43	5	36	30.01	30.06	.....	59.6	.....	82	4	70	30	1	49	30	.....	.....	.....	7.59	.....	12	.....	n.	.....	.....	.....	10	11	8	.....	.0	.0
East Gulf States							47.5	−3.7										75	6.73	+1.8										6.5		
Atlanta [1]	976	5	53	29.04	30.10	−.02	41.6	−3.7	74	25	51	10	1	32	34	36	32	75	8.42	+3.5	14	6,594	nw.	35	sw.	4	7	6	16	6.8	2.5	.0
Macon	370	79	87	29.70	30.10	−.02	46.0	−3.3	75	26	56	17	1	36	34	39	33	69	7.02	+2.4	13	4,988	nw.	30	nw.	4	11	4	14	5.8	T	.0
Thomasville	273	49	58	29.80	30.10	−.02	50.6	−4.4	76	25	60	21	1	41	29	46	44	86	7.18	+2.7	14	.....	ne.	.....	.....	.....	11	2	16	.....	.....	.0
Apalachicola	35	11	.....	30.03	30.07	.....	52.2	.....	69	26	58	28	1	46	24	48	.....	.....	3.47	−.6	15	.....	n.	.....	.....	.....	7	10	12	.....	.0	.0
Pensacola	56	149	185	30.02	30.08	−.03	52.4	−2.8	70	26	60	28	11	45	31	49	47	86	6.40	+1.9	12	9,111	n.	34	n.	18	10	7	12	5.7	.0	.0
Anniston	741	9	.....	.....	.....	.....	43.4	−2.4	74	25	54	2	1	33	38	.....	.....	.....	8.31	+3.5	11	.....	nw.	.....	.....	.....	7	8	14	.....	T	.0
Birmingham	700	11	48	29.31	30.10	−.02	43.7	−4.3	74	25	54	11	1	34	36	38	32	71	7.34	+2.1	11	5,529	nw.	40	s.	3	7	4	18	6.8	.1	.0
Mobile	57	86	105	30.01	30.07	−.04	51.2	−3.5	77	14	61	26	19	42	31	45	42	78	4.03	−1.5	13	6,214	n.	29	nw.	4	8	9	12	5.9	T	.0
Montgomery	218	92	105	29.85	30.11	−.01	48.6	−3.0	76	26	58	21	1	39	36	42	36	69	7.29	+1.6	16	5,316	n.	28	n.	4	8	7	16	7.1	.0	.0
Meridian	375	67	92	29.68	30.09	−.02	45.8	−3.8	78	25	57	17	18	35	37	40	34	71	10.88	+5.2	11	4,971	ne.	26	w.	3	8	7	14	6.2	.0	.0
Vicksburg	247	65	73	29.82	30.10	.00	45.8	−6.0	79	24	55	14	18	36	29	40	34	70	4.93	.0	8	5,828	n.	29	nw.	3	4	7	18	7.5	T	.0
New Orleans	53	76	84	30.01	30.07	−.02	54.1	−3.2	79	14	62	30	19	46	30	49	45	78	5.46	+1.1	9	5,802	ne.	28	ne.	20	8	10	11	6.3	.0	.0
West Gulf States							45.7	−5.9										72	1.24	−1.4										6.2		
Shreveport	249	92	227	29.80	30.08	−.01	44.6	−6.3	80	25	54	13	18	35	35	39	34	69	1.40	−2.0	9	7,948	ne.	45	nw.	3	12	5	12	5.8	.8	.0
Bentonville	1,303	12	38	28.66	30.08	−.02	31.5	−7.0	72	25	41	−4	18	22	36	.....	.....	.....	1.34	−.8	6	5,992	nw.	30	s.	23	7	11	11	.....	.6	.0
Fort Smith	457	79	94	29.58	30.07	−.03	35.9	−6.9	77	24	46	3	18	26	36	30	24	67	.87	−1.8	5	6,393	e.	32	w.	26	10	10	9	5.7	1.1	.0
Little Rock	357	94	102	29.72	30.11	.00	36.8	−8.1	76	25	45	5	18	29	31	32	26	67	1.30	−2.7	9	6,364	e.	29	sw.	24	9	8	12	5.6	4.1	.0
Austin	605	136	148	29.38	30.02	.....	48.6	−4.8	82	13	60	16	18	37	42	42	36	66	1.70	−.7	5	6,168	n.	30	n.	3	7	9	13	6.1	.0	.0
Brownsville	57	88	96	29.91	29.97	.....	58.4	−4.2	88	13	67	28	18	50	33	54	52	86	1.56	+.3	12	8,509	nw.	34	n.	4	2	11	16	7.5	.0	.0
Corpus Christi	20	11	78	29.99	30.01	−.04	52.8	−5.6	83	3	61	25	18	45	32	49	46	83	.34	−1.2	8	7,347	n.	35	n.	4	3	10	16	7.6	.0	.0
Dallas	512	220	227	29.48	30.05	.....	42.0	.....	77	12	53	10	18	31	53	35	28	62	.28	−2.1	6	8,890	n.	38	nw.	14	7	13	9	5.3	T	.0
Fort Worth	679	92	110	29.34	30.07	.00	42.2	−6.1	80	12	54	10	18	30	57	.....	.....	.....	.48	−1.4	3	7,893	n.	38	n.	3	15	7	7	3.8	T	.0
Galveston	54	106	114	29.98	30.04	−.03	51.2	−5.1	72	21	57	28	18	45	28	48	46	85	1.42	−1.5	12	7,790	n.	32	nw.	4	5	8	16	7.0	.0	.0
Houston	138	292	314	29.89	30.05	.....	50.1	−5.8	82	13	59	19	18	41	35	.....	.....	.....	2.11	−1.2	11	8,934	n.	38	n.	4	7	5	17	7.0	.0	.0
Palestine	510	64	72	29.52	30.06	−.02	44.8	−6.4	78	25	56	13	18	34	36	40	34	69	.94	−2.2	12	5,927	s.	23	nw.	3	8	9	12	5.9	.1	.0
Port Arthur	34	58	66	30.01	30.05	.....	51.2	.....	82	13	63	19	18	39	42	45	39	69	3.08	−.5	12	6,386	n.	35	n.	4	6	6	17	6.4	.0	.0
San Antonio	693	242	301	29.27	30.00	−.05	51.0	−4.4	82	13	63	19	18	39	42	45	39	69	.40	−1.4	6	7,648	ne.	35	n.	3	6	9	14	6.6	.0	.0

[1] Observations taken at airport.

TABLE 1.—*Climatological data for Weather Bureau stations, February 1936*—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
Ohio Valley and Tennessee	*Ft.*	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	*° F.*	*° F.*	*°F.*		*°F.*	*° F.*		*° F.*	*° F.*	*° F.*	*° F.*	*%*	*In.*	*In.*		*Miles*								*0–10*	*In.*	*In.*
							29.6	**−6.5**										**74**	**2.75**	**−0.7**										**6.2**		
Chattanooga	762	71	214	29.28	30.12	−0.01	40.7	−3.4	75	25	50	14	1	31	34	35	29	68	5.64	+.6	11	5,842	ne.	27	se.	8	11	6	12	5.6	5.5	0.0
Knoxville	995	66	84	29.03	30.11	−.01	37.8	−4.1	73	26	47	10	11	29	34	35	32	81	4.36	−.3	15	4,517	e.	22	w.	4	11	5	13	5.9	14.4	.0
Memphis	399	78	86	29.67	30.11	.00	36.6	−7.7	77	25	44	1	18	29	25	32	27	69	1.82	−2.7	12	5,822	n.	27	nw.	4	10	4	15	5.7	7.4	.0
Nashville	546	168	291	29.53	30.14	+.02	35.7	−5.9	73	25	45	−1	18	26	35	31	26	71	1.52	−2.8	12	7,026	nw.	32	nw.	4	11	3	15	5.9	5.0	.0
Lexington	989	6	.....	.....	.....	.....	29.6	−5.8	69	26	38	−6	18	22	30	.....	.....	.....	2.07	−1.3	12	.....	sw.	.....	.....	.....	9	7	13	.....	4.8	.0
Louisville	525	188	234	29.53	30.14	+.03	29.6	−7.6	69	25	39	−7	18	20	37	26	22	74	2.10	−1.5	11	7,620	n.	38	w.	4	7	11	11	6.0	4.9	.0
Evansville	431	76	116	29.64	30.13	+.02	28.8	−7.5	66	25	38	−6	18	20	37	26	21	73	1.56	−1.8	9	6,764	s.	32	w.	4	9	5	15	6.1	5.3	.0
Indianapolis	822	194	230	29.19	30.11	+.01	21.8	−9.3	61	24	31	−11	18	12	43	20	15	73	3.21	+.4	8	8,507	w.	36	w.	27	5	8	16	6.9	7.5	.0
Terre Haute	575	96	129	29.46	30.10	.....	23.6	.....	63	24	33	−9	18	14	39	21	17	77	3.87	+1.2	10	7,212	ne.	30	w.	4	10	4	15	6.1	5.9	.0
Cincinnati	627	11	51	29.41	30.12	+.02	26.8	−6.0	67	26	36	−8	18	18	33	23	18	72	2.04	−1.0	10	6,163	w.	34	sw.	4	8	6	15	6.5	7.5	.0
Columbus	822	90	210	29.20	30.11	+.02	24.4	−6.3	65	26	33	−7	18	16	33	22	16	72	2.87	+.1	12	7,476	s.	43	sw.	4	9	10	10	5.7	9.6	.0
Dayton	900	58	153	29.10	30.10	.....	24.4	−7.0	64	26	33	−9	18	15	34	.....	.....	.....	2.99	+.2	8	7,062	sw.	33	w.	4	7	8	14	6.3	7.9	.0
Elkins	1,947	59	78	27.98	30.15	+.05	27.5	−4.1	68	26	39	−6	8	16	46	24	21	82	2.92	−.3	13	4,640	w.	30	sw.	27	4	9	16	7.2	10.4	.0
Parkersburg	637	77	84	29.46	30.15	+.05	27.8	−6.4	73	26	37	−8	19	18	39	24	20	75	1.92	−1.3	15	4,834	sw.	30	sw.	4	7	9	13	6.1	10.4	.0
Pittsburgh [1]	842	164	410	28.67	30.08	−.01	22.9	−9.4	58	25	32	−8	19	14	36	20	16	79	2.30	−.4	16	7,762	sw.	45	sw.	4	5	10	14	6.5	10.7	.0
Lower Lake Region							**18.1**	**−6.9**										**80**	**2.45**	**−0.1**										**6.8**		
Buffalo	768	243	280	29.19	30.06	.00	18.5	−5.8	49	24	26	−3	18	11	28	16	13	84	2.37	−.7	17	13,717	sw.	70	sw.	4	4	9	16	7.1	14.3	1.1
Canton	448	10	61	29.54	30.05	.....	12.1	−5.9	46	25	21	−11	7	3	29	11	9	92	2.14	−.2	15	7,383	w.	44	sw.	4	5	9	15	6.5	15.1	3.5
Ithaca	836	77	100	29.14	30.08	.....	18.6	−5.9	55	25	28	−6	3	9	33	16	11	75	1.14	−.9	10	6,828	w.	31	se.	4	6	10	13	6.3	7.1	.0
Oswego	335	71	85	29.68	30.07	+.01	18.2	−5.7	48	25	25	−4	22	11	26	16	12	77	3.01	+.2	19	8,727	se.	31	w.	28	3	3	23	8.2	40.5	12.5
Rochester	523	86	102	29.48	30.08	+.02	18.8	−5.8	50	25	26	−2	18	12	23	16	11	70	1.57	−1.2	18	7,984	sw.	41	sw.	4	4	11	14	6.8	11.9	4.0
Syracuse	596	65	79	29.45	30.09	+.02	19.2	−4.6	53	25	26	−1	19	12	25	.....	.....	.....	1.90	−.9	16	6,164	sw.	24	s.	9	5	8	16	7.0	15.5	3.5
Erie	714	130	166	29.28	30.08	+.01	19.4	−7.5	54	25	27	−3	19	12	29	17	13	76	2.37	−.3	16	9,905	w.	47	w.	4	2	11	16	7.5	11.3	T
Cleveland	762	267	318	29.22	30.08	+.01	21.0	−6.4	60	25	29	−5	18	13	37	19	16	80	2.19	−.4	14	11,523	sw.	51	sw.	4	6	8	15	6.9	9.1	.0
Sandusky	629	5	67	29.38	30.10	+.03	20.0	−7.4	54	24	28	−6	18	12	31	.....	.....	.....	3.02	+.8	13	7,617	sw.	38	sw.	4	4	12	13	6.8	7.9	.0
Toledo	628	79	87	29.38	30.10	+.03	17.8	−9.5	51	24	26	−9	18	10	32	16	12	78	2.76	+.6	10	7,967	w.	40	w.	4	6	11	12	6.2	8.7	T
Fort Wayne	857	69	84	29.13	30.10	.....	17.2	−8.6	53	24	26	−13	18	8	40	15	13	85	4.25	+1.8	9	7,515	w.	35	w.	4	5	10	14	6.6	9.2	T
Detroit [1]	626	5	78	29.36	30.08	+.02	16.0	−9.3	50	24	25	−9	18	7	39	14	11	82	2.62	+.4	15	8,320	sw.	41	w.	27	7	6	16	6.3	14.7	T
Upper Lake Region							**8.7**	**−10.3**										**79**	**1.86**	**0.0**										**6.2**		
Alpena	609	13	89	29.33	30.04	+.01	10.0	−8.0	49	24	20	−14	21	0	39	8	3	76	2.00	+.2	12	8,502	w.	38	se.	9	11	4	14	5.6	27.2	21.0
Escanaba	612	54	60	29.35	30.06	.00	4.4	−11.0	43	24	14	−24	5	−5	28	4	−1	78	1.41	−.1	11	7,037	w.	34	w.	27	9	10	10	5.3	19.5	8.1
Grand Rapids	707	70	244	29.26	30.06	+.01	15.0	−8.7	52	24	22	−10	18	8	28	13	9	79	2.18	−.1	16	8,456	w	46	sw.	27	3	8	18	7.8	27.3	6.0
Lansing	878	6	88	29.07	30.06	.....	12.8	−10.1	46	24	21	−14	18	4	37	11	9	86	1.62	−.3	16	7,352	sw.	36	w.	4	7	5	17	7.3	16.9	2.0
Ludington	637	5	54	29.32	30.05	.....	13.2	−9.3	44	24	20	−15	22	6	33	11	.....	.....	2.42	+.3	18	.....	w.	.....	.....	.....	6	6	17	.....	26.2	12.0
Marquette	734	77	111	29.19	30.04	−.01	6.7	−9.6	41	24	15	−22	5	−2	33	5	2	84	2.33	+.4	11	6,843	w.	34	se.	8	10	6	13	5.6	24.0	25.5
Sault Ste. Marie	614	11	52	29.29	30.04	+.01	4.8	−7.8	38	24	14	−17	21	−5	38	4	1	86	1.84	−.2	19	6,135	w.	29	nw.	27	7	7	15	6.4	31.7	18.9
Chicago	673	7	131	29.33	30.10	+.02	15.2	−11.1	56	24	24	−14	18	7	40	13	8	74	1.33	−.9	10	8,249	w.	32	w.	26	7	4	18	6.8	12.7	.0
Green Bay	617	109	141	29.36	30.07	+.01	4.6	−12.8	43	24	14	−22	5	−5	37	4	−1	75	1.45	−.2	8	7,862	sw.	32	ne.	3	5	10	14	6.6	17.6	10.2
Milwaukee	681	97	221	29.30	30.08	+.02	10.8	−12.0	48	24	19	−17	18	2	42	9	5	75	2.32	+.4	11	9,975	w.	46	se.	8	6	9	14	6.4	23.8	3.3
Duluth	1,133	5	47	28.76	30.08	.00	−1.9	−13.3	38	24	8	−33	5	−11	30	−5	−9	78	1.57	+.5	6	10,692	nw.	40	nw.	14	19	3	7	3.7	16.7	18.0
North Dakota							**−12.4**	**−20.4**										**86**	**0.81**	**+0.3**										**5.2**		
Moorhead, Minn	940	50	58	29.10	30.21	+.10	−9.8	−17.9	30	23	−1	−37	15	−18	33	−10	−11	97	1.38	+.7	11	6,130	n.	23	nw.	9	9	5	15	5.8	18.0	17.8
Bismarck	1,674	8	57	28.28	30.23	+.11	−11.4	−21.7	23	23	−2	−45	16	−21	33	−12	−15	80	.59	+.1	10	4,852	nw.	25	nw.	17	9	13	7	5.0	9.3	14.6
Devils Lake	1,478	11	44	28.50	30.23	+.12	−15.0	−20.1	21	23	−6	−46	15	−24	29	−16	−19	86	.65	+.1	8	6,186	nw.	32	n.	26	10	6	13	5.8	7.2	16.1
Williston	1,878	41	48	28.09	30.25	+.14	−13.6	−21.7	34	29	−5	−50	16	−22	35	−14	−18	79	.61	+.2	9	3,746	w.	24	nw.	17	13	10	6	4.3	6.9	16.6
Upper Mississippi Valley							**12.1**	**−12.8**										**81**	**1.76**	**0.0**										**6.2**		
Minneapolis	919	105	208	29.07	30.12	+.03	.0	−15.9	41	24	8	−26	16	−8	27	−1	−3	89	1.55	+.6	10	7,600	w.	28	w.	4	8	9	12	6.0	19.7	14.5
La Crosse	714	11	48	29.30	30.13	+.05	4.3	−14.9	42	24	14	−23	16	−6	38	3	0	85	2.02	+.9	16	3,942	w.	18	sw.	8	7	5	17	6.4	27.1	12.6
Madison	974	70	78	28.97	30.10	+.03	5.9	−13.2	46	24	15	−21	5	−3	43	5	3	87	1.90	+.3	13	6,490	w.	27	se.	26	7	8	14	6.7	17.9	8.0
Charles City	1,015	10	51	28.99	30.14	+.04	2.2	−14.9	40	23	12	−24	5	−8	41	1	−2	85	1.97	+.8	16	5,518	w.	28	sw.	26	8	8	13	6.3	25.4	18.0
Davenport	606	66	161	29.43	30.14	+.04	11.6	−13.3	55	24	20	−15	5	3	43	10	6	78	1.76	+.1	11	7,410	ne.	32	w.	26	9	4	16	6.4	11.5	.4
Des Moines	861	5	99	29.19	30.16	+.05	8.0	−15.7	48	28	16	−18	5	0	34	6	3	82	.95	−.2	10	7,557	n.	34	nw.	8	6	13	10	6.0	12.4	1.2
Dubuque	700	60	79	29.33	30.14	+.05	7.8	−14.4	46	24	17	−19	5	−1	44	6	2	79	1.72	+.3	11	4,929	nw.	22	se.	26	7	4	18	6.9	17.8	1.6
Keokuk	614	64	78	29.44	30.17	+.06	15.9	−12.4	71	24	25	−13	18	7	43	12	8	75	1.89	+.3	12	6,527	w.	27	w.	26	8	7	14	6.0	5.5	.0
Cairo	358	87	93	29.72	30.12	.00	31.0	−7.5	71	25	39	−4	18	23	26	28	23	73	2.01	−1.2	10	6,516	n.	30	s.	24	8	7	14	6.2	8.0	.0
Peoria	609	11	45	29.44	30.14	+.04	14.8	−11.1	64	24	24	−14	18	6	42	13	9	81	1.63	−.4	12	6,072	w.	25	w.	26	10	6	13	5.6	7.3	.0
Springfield, Ill	636	5	191	29.40	30.11	+.01	19.7	−9.8	66	24	29	−9	18	11	37	18	16	86	1.74	−.7	9	8,534	w.	35	w.	27	10	5	14	6.0	1.6	.0
St. Louis	568	179	303	29.48	30.11	.00	24.4	−10.1	74	24	33	−8	18	16	35	22	17	74	1.97	−.7	6	8,246	nw.	39	nw.	4	11	6	12	5.4	2.1	.0
Missouri Valley							**12.7**	**−13.2**										**81**	**0.85**	**−0.5**										**5.8**		
Columbia, Mo	784	6	84	29.24	30.12	+.01	21.4	−10.3	74	24	31	−10	18	12	37	.....	.....	.....	1.40	−.7	8	6,820	w.	27	nw.	25	12	8	9	4.9	2.7	.0
Kansas City [1]	750	32	45	29.28	30.13	+.02	19.6	−11.6	74	24	29	−7	8	10	45	16	11	75	.55	−1.3	8	7,647	ne.	34	sw.	23	8	9	12	6.0	5.7	.0
St. Joseph	967	11	49	29.04	30.13	.....	15.6	.....	69	24	25	−11	9	6	42	13	8	78	.44	−1.0	7	6,831	nw.	31	nw.	26	10	9	10	5.1	4.5	.0
Springfield, Mo	1,324	98	104	28.62	30.07	−.04	27.6	−7.6	74	24	37	−8	18	18	29	24	19	72	1.01	−1.4	8	7,547	se.	34	w.	26	15	5	9	4.3	2.3	.0
Iola	984	11	50	29.02	30.12	+.02	25.8	−7.4	71	24	37	−5	8	14	45	.....	.....	.....	.24	−1.5	7	.....	nw.	.....	.....	.....	5	17	7	.....	4.1	.0
Topeka	987	65	87	.....	.....	.....	19.4	−11.6	76	24	29	−9	8	10	45	.....	.....	.....	.42	−1.1	8	6,795	nw.	29	nw.	8	10	13	6	4.8	4.6	.0
Lincoln	1,189	11	81	28.81	30.16	+.06	8.8	−17.3	53	23	18	−20	5	0	38	7	3	78	.68	−.3	11	7,353	n.	32	nw.	8	5	14	10	6.2	9.4	T
Omaha	1,105	170	200	29.05	30.19	+.08	6.5	−19.0	46	23	15	−18	5	−2	30	5	2	82	.69	−.2	11	7,561	nw.	35	w.	3	5	12	12	6.2	13.5	1.8
Valentine	2,598	47	54	27.27	30.20	+.11	1.8	−19.6	52	29	13	−32	6	−9	48	0	−2	88	.97	+.4	12	5,595	w.	30	sw.	25	4	10	15	6.9	20.3	2.0
Sioux City	1,138	64	106	28.87	30.18	+.06	1.9	−19.1	44	28	10	−25	16	−7	29	1	−1	88	2.11	+1.3	15	7,084	nw.	41	nw.	26	6	9	14	6.9	25.0	8.8
Huron	1,306	60	74	28.71	30.22	+.10	−5.4	−8.9	33	23	3	−33	16	−14	32	−6	−8	88	.88	+.3	13	6,238	nw.	27	nw.	8	8	8	13	6.3	14.7	10.2
Northern Slope							**5.1**	**−16.7**										**77**	**1.09**	**+0.3**										**6.6**		
Havre	2,505	11	67	27.40	30.28	+.21	−12.8	−26.4	44	29	−2	−47	16	−24	43	−13	−14	97	.78	+.3	11	5,185	w.	28	sw.	29	11	8	10	5.2	12.6	4.7
Helena	4,124	85	111	25.66	30.12	+.01	2.0	−21.0	51	29	11	−36	8	−7	40	0	−5	77	1.51	+.8	17	4,044	nw.	27	sw.	29	3	7	19	7.7	31.1	7.0
Missoula	3,263	80	91	.....	.....	.....	12.2	.....	50	29	20	−25	8	5	41	.....	.....	.....	2.63	+1.8	18	4,332	w.	31	e.	11	2	7	20	8.1	43.5	9.2
Kalispell	2,973	48	56	.....	30.08	.00	6.2	−17.1	48	22	16	−28	15	−3	32	.....	.....	80	2.10	+1.0	16	4,346	nw.	28	n.	5	7	4	18	.....	30.7	13.0
Miles City	2,371	48	55	27.50	30.26	+.17	−5.6	−22.4	43	27	4	−45	15	−15	33	−7	−16	63	.40	−.1	5	3,875	ne.	26	nw.	7	7	11	11	5.9	6.8	4.0
Rapid City	3,259	50	58	26.53	30.21	+.13	1.4	−22.0	58	23	12	−33	8	−9	42	0	−3	87	.59	+.1	10	4,532	se.	27	n.	13	5	15	9	6.0	7.5	T
Cheyenne	6,094	50	71	23.69	29.92	−.11	20.2	−7.1	63	22	36	−34	8	5	57	16	9	67	.59	−.1	11	11,337	w.	49	nw.	26	0	17	12	7.0	7.0	.0
Lander	5,372	60	68	24.41	30.01	−.07	12.0	−10.5	58	29	26	−40	8	−2	58	8	4	80	.57	−.1	6	4,072	sw.	38	sw.	22	8	18	3	4.9	7.2	T
Sheridan	3,790	10	47	25.97	30.12	.....	3.8	.....	58	22	16	−38	8	−9	46	1	−4	74	.85	+.1	12	3,737	nw.	32	nw.	25	5	13	11	6.3	11.7	.8
Yellowstone Park	6,241	11	46	23.60	29.98	−.12	10.9	−8.7	42	28	22	−35	8	0	54	9	5	74	1.00	+.2	21	6,579	sw.	32	sw.	12	0	6	23	8.6	29.5	17.9
North Platte	2,821	12	51	27.02	30.12	+.05	11.4	−15.2	66	22	23	−25	8	0	47	8	1	67	.40	−.2	8	5,286	n.	28	nw.	26	6	10	13	6.7	4.7	.0

[1] Observations taken at airport.

TABLE 1.—*Climatological data for Weather Bureau stations, February 1936*—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	*° F.*	*° F.*	*° F.*		*° F.*	*° F.*		*° F.*	*° F.*	*° F.*	*° F.*	*%*	*In.*	*In.*		*Miles*								*0–10*	*In.*	*In.*
Middle Slope							25.5	−8.3										61	0.29	−0.6										5.1		
Denver	5,292	106	113	24.52	29.92	−0.09	26.8	−5.9	72	22	42	−25	8	12	60	20	9	52	0.31	−0.2	4	5,969	n.	31	nw.	25	7	14	8	5.5	5.6	0.0
Pueblo	4,685	80	86	25.12	29.92	−.08	27.3	−5.6	72	22	42	−13	4	13	52	21	10	54	.44	.0	3	5,497	e.	49	w.	23	12	13	4	4.4	5.0	.0
Concordia	1,392	50	58	28.60	30.16	+.07	16.8	−13.0	70	24	27	−14	8	6	48	13	9	79	.14	−.8	7	6,404	ne.	26	n.	8	7	15	7	5.6	3.0	.0
Dodge City	2,509	10	86	27.36	30.08	+.02	23.6	−9.6	80	23	37	−14	8	10	53	17	7	56	.06	−.7	6	8,369	s.	44	n.	7	14	6	9	4.7	.7	.0
Wichita	1,358	85	93	28.59	30.08	.00	25.0	−9.4	76	24	36	−8	8	14	39	29	12	63	.02	−1.3	1	7,683	ne.	31	sw.	23	14	4	11	5.0	.1	.0
Oklahoma City	1,214	10	47	28.73	30.05	−.02	33.5	−6.1	79	24	45	−1	8	22	44	27	18	60	.76	−.4	3	7,630	s.	30	n.	14	11	8	10	5.3	.1	.0
Southern Slope							44.3	−1.6										49	0.10	−0.6										4.4		
Abilene	1,738	10	52	28.16	30.00	−.05	44.9	−2.3	85	24	60	9	8	29	52	34	23	50	.12	−.9	2	7,944	s.	33	w.	3	8	14	7	5.1	T	.0
Amarillo	3,676	10	49	26.15	29.96	−.06	33.5	−4.6	73	22	48	−3	8	19	56	26	15	52	.25	−.5	1	6,543	se.	25	ne.	13	13	9	7	4.2	2.5	.0
Del Rio	944	64	71	28.96	29.96	−.04	54.0	−2.0	83	12	67	22	18	41	44	44	34	54	.01	−.6	1	6,241	se.	30	n.	3	9	11	9	5.4	.0	.0
Roswell	3,566	75	85	26.26	29.90	−.08	44.8	+2.3	77	23	60	13	8	29	46	34	19	41	.04	−.6	3	6,359	s.	43	nw.	17	17	10	2	3.1	.1	.0
Southern Plateau							48.4	+0.8										52	0.90	+0.3										4.2		
El Paso	3,778	152	175	26.12	29.92	−.03	51.2	+2.2	75	23	63	29	18	40	35	40	26	42	.06	−.4	1	9,259	w.	48	w.	3	14	13	2	3.3	.0	.0
Albuquerque	4,972	5	39	24.94	29.87	.....	39.9	.....	66	23	54	13	4	26	42	31	21	53	.12	−.2	4	7,059	w.	37	nw.	13	9	10	10	5.3	.3	.0
Santa Fe	7,013	38	53	23.10	29.90	−.08	33.4	+.3	57	22	43	7	4	24	30	28	22	63	.98	+.2	10	4,830	n.	26	sw.	12	12	6	11	5.1	9.6	.0
Flagstaff	6,907	10	59	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Phoenix	1,108	10	107	28.79	29.96	−.03	56.4	+1.3	83	29	68	34	5	44	41	46	37	52	1.01	+.2	8	3,857	e.	26	sw.	15	15	5	9	4.1	.0	.0
Yuma	141	9	54	29.83	29.98	−.02	59.6	+1.0	84	28	73	32	6	46	40	49	36	48	.18	−.2	3	4,516	w.	28	nw.	12	15	12	2	3.3	.0	.0
Independence	3,957	5	26	25.89	29.96	−.10	41.6	−.6	68	22	53	21	4	30	32	35	.....	.....	3.02	+2.2	12	.....	n.	.....	.....	.....	12	4	13	.....	2.0	.0
Middle Plateau							34.9	+1.5										71	2.18	+1.1										7.0		
Reno	4,527	61	76	25.36	29.96	−.12	36.0	+.4	60	21	45	13	4	27	30	32	26	70	3.01	+1.8	11	4,337	w.	40	sw.	21	6	11	12	6.1	11.2	.0
Tonopah	6,090	12	20	.....	.....	.....	33.0	.....	53	27	41	10	4	25	26	29	22	68	.82	.....	9	.....	se.	.....	.....	.....	.....	.....	.....	.....	.....	.....
Winnemucca	4,344	18	56	25.49	29.93	−.16	35.3	+1.8	61	21	44	0	3	26	32	32	28	77	2.01	+1.1	13	6,220	sw.	36	sw.	24	1	11	17	7.8	3.9	.0
Modena	5,473	10	46	24.49	29.88	−.16	34.0	+3.0	57	27	44	5	4	24	36	30	24	70	1.65	+.7	10	7,942	sw.	36	sw.	1	9	6	14	5.9	4.0	.0
Salt Lake City [1]	4,357	86	210	25.59	29.91	−.17	32.4	−1.4	54	27	41	−7	8	24	36	30	20	78	3.22	+1.6	15	6,637	se.	47	nw.	25	0	8	21	8.6	20.9	.0
Grand Junction	4,602	60	68	25.23	29.83	−.21	36.6	+3.7	58	28	46	12	8	27	30	31	24	63	1.02	+.4	10	4,535	se.	31	sw.	24	5	10	14	6.4	3.0	.0
Northern Plateau							22.9	−9.7										74	1.77	+0.3										8.2		
Baker	3,471	48	53	26.31	29.99	−.13	20.5	−8.5	46	22	30	−14	8	11	32	19	15	74	1.64	+.4	18	4,218	s.	26	sw.	22	1	6	22	8.5	20.5	.6
Boise	2,739	79	87	27.07	30.01	−.11	28.4	−6.4	57	22	37	−3	8	20	33	25	20	73	2.26	+.8	14	3,761	se.	24	n.	7	1	3	25	8.7	13.2	.0
Pocatello	4,477	60	68	25.30	29.92	−.18	27.0	−1.9	48	21	34	−6	8	20	33	24	20	74	2.04	+.7	20	7,835	sw.	31	sw.	13	2	6	21	8.2	16.5	.0
Spokane	1,929	101	110	27.88	30.02	−.07	17.4	−13.9	51	29	25	−16	15	10	26	16	13	80	1.57	−.2	15	4,438	n.	27	sw.	22	7	4	18	7.2	21.2	T
Walla Walla	991	57	65	28.94	30.05	−.06	21.5	−15.6	60	29	27	−5	17	16	34	20	15	75	2.26	+.4	13	3,750	s.	21	sw.	5	2	5	22	8.6	17.4	T
Yakima	1,076	58	67	28.83	30.03	.....	22.8	−11.7	65	29	31	−1	7	14	33	20	14	69	.84	−.2	8	3,457	nw.	26	w.	9	2	5	22	8.0	9.9	.0
North Pacific Coast Region							37.7	−4.4										74	5.20	−0.4										8.2		
North Head	211	11	56	29.67	29.90	−.16	38.8	−4.2	50	21	44	23	13	34	18	37	33	78	7.85	+.2	17	10,145	e.	63	s.	21	1	7	21	8.2	2.0	.0
Seattle	125	90	321	29.77	29.91	−.15	36.3	−4.8	52	29	42	19	7	31	19	62	25	65	4.64	+.7	12	6,652	n.	34	s.	26	3	7	19	7.2	5.8	.0
Tatoosh Island	86	10	54	29.78	29.88	−.12	36.8	−4.2	48	29	40	21	7	34	18	34	28	71	6.36	−3.4	15	14,597	e.	58	e.	17	1	8	20	7.9	4.6	.0
Medford	1,329	29	58	28.51	29.94	.....	42.8	.....	65	29	51	20	1	34	34	40	36	80	2.68	+.3	17	.....	n.	.....	.....	.....	3	5	21	7.7	2.7	.0
Portland, Oreg	153	68	106	29.80	29.96	−.12	33.9	−8.2	56	28	39	14	8	29	24	31	25	71	4.73	−.8	15	5,856	e.	26	se.	22	2	3	24	8.8	3.3	.0
Roseburg	510	45	76	29.39	29.94	−.16	42.8	−.6	69	29	50	25	1	36	32	40	37	82	4.97	+.3	21	3,029	n.	21	sw.	21	0	6	23	9.1	T	.0
Middle Pacific Coast Region							51.2	+1.3										76	8.18	+3.6										6.4		
Eureka	62	73	89	29.89	29.96	−.15	49.6	+2.4	64	11	56	34	3	44	21	46	43	80	5.89	−.8	21	5,081	se.	32	sw.	21	5	7	17	6.7	.0	.0
Redding	722	20	34	.....	.....	.....	47.9	.....	79	29	55	31	3	41	28	44	38	71	9.56	.....	17	5,887	nw.	38	s.	21	7	3	19	7.3	T	.0
Sacramento	69	92	115	29.92	29.98	−.11	50.5	+.4	68	29	58	33	4	43	25	47	43	76	8.59	+5.5	16	5,552	s.	22	s.	21	9	7	13	5.7	.0	.0
San Francisco	155	208	243	29.81	29.98	−.12	53.4	+1.2	71	29	59	40	3	48	22	49	45	78	10.06	+6.1	17	5,046	se.	27	sw.	21	7	6	16	6.4	.0	.0
South Pacific Coast Region							54.8	+0.9										77	5.71	+3.5										6.3		
Fresno	327	97	105	29.67	30.03	−.05	51.6	+.5	70	29	60	32	5	43	28	48	45	79	4.70	+3.2	16	4,452	e.	25	nw.	23	5	10	14	6.6	.0	.0
Los Angeles	338	159	191	29.66	30.02	−.04	56.5	+1.0	83	29	64	43	7	49	29	50	45	73	7.25	+4.1	12	4,393	ne.	20	ne.	18	10	6	13	5.8	.0	.0
San Diego	87	62	70	29.94	30.03	−.03	56.3	+1.2	72	27	63	43	9	50	23	52	49	79	5.18	+3.1	13	4,897	w.	29	s.	14	8	5	16	6.5	.0	.0
West Indies																																
San Juan, P. R.	82	9	54	29.93	30.02	.....	75.6	+.7	87	11	81	68	11	70	19	.....	.....	.....	1.03	−1.8	9	8,470	e.	34	ne.	24	8	19	2	4.6	.0	.0
Panama Canal																																
Balboa Heights	118	6	92	.....	[3] 29.85	.00	80.0	.....	93	17	89	67	12	71	25	.....	.....	[2] 74	T	−.7	0	5,692	nw.	27	nw.	4	14	15	0	3.8	.0	.0
Cristobal	36	6	97	.....	[3] 29.88	−.01	80.6	.....	87	25	85	71	12	76	15	74	71	[2] 75	.13	−1.4	5	7,808	n.	27	n.	23	19	8	2	3.7	.0	.0
Alaska																																
Fairbanks	454	11	87	[3] 29.71	[3] 30.30	.....	−14.4	.....	15	1	−3	−30	9	−26	40	−11	−17	73	.15	.....	4	3,078	n.	24	ne.	29	16	4	9	4.1	3.3	16.0
Juneau	80	96	116	[3] 29.96	[3] 30.06	.....	15.0	.....	42	29	20	−5	5	10	18	13	0	51	2.40	.....	6	7,383	ne.	30	ne.	24	15	5	9	4.1	23.1	14.2
Hawaiian Islands																																
Honolulu	38	86	100	[3] 29.86	[3] 29.90	.....	71.8	+1.0	82	27	77	60	9	66	16	65	62	75	1.26	−2.6	8	5,979	ne.	30	w.	2	15	11	3	4.3	.0	.0

[1] Observations taken at airport. [2] Observations taken hourly. [3] Pressure not reduced to mean of 24 hours.

TABLE 2.—*Data furnished by the Canadian Meteorological Service, February 1936*

Station	Altitude above mean sea level, Jan. 1, 1919	Pressure			Temperature of the air						Precipitation		
		Station reduced to mean of 24 hours	Sea level reduced to mean of 24 hours	Departure from normal	Mean max.+ mean min.÷2	Departure from normal	Mean maximum	Mean minimum	Highest	Lowest	Total	Departure from normal	Total snowfall
	Ft.	*In.*	*In.*	*In.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*In.*	*In.*	*In.*
Cape Race, Newfoundland	99				23.9		29.9	17.9	45	−1	3.08		6.4
Sydney, Cape Breton Island	48	29.79	29.84	−0.08	19.7	+0.4	27.9	11.6	45	−2	3.47	−0.62	16.3
Halifax, Nova Scotia	88	29.66	29.77	−.18	19.5	−2.9	25.8	13.2	41	−1	2.58	−5.16	14.0
Yarmouth, Nova Scotia	65	29.83	29.90	−.09	23.6	−2.2	29.7	17.5	45	4	2.46	−1.71	14.8
Charlottetown, Prince Edward Island	38	29.82	29.86	−.09	16.0	−1.6	23.7	8.3	42	−10	2.01	−1.05	15.1
Chatham, New Brunswick	28	29.78	29.82	−.14	11.4	−1.1	22.7	.1	43	−19	1.36	−1.80	10.4
Father Point, Quebec	20												
Quebec, Quebec	296	29.66	30.00	−.01	9.6	−2.2	16.2	3.1	34	−10	2.98	−.29	27.5
Doucet, Quebec	1,236												
Montreal, Quebec	187												
Ottawa, Ontario	236												
Kingston, Ontario	285	29.72	30.06	+.02	13.7	−4.1	21.8	5.7	41	−10	2.79	+.25	13.9
Toronto, Ontario	379	29.64	30.07	+.03	17.5	−4.0	24.7	10.2	47	−3	2.61	.00	19.3
Cochrane, Ontario	930				−2.4		6.4	−11.1	34	−29	1.91		17.2
White River, Ontario	1,244	28.59	30.00	−.02	−6.6	−6.8	6.7	−19.9	33	−46	1.28	−.24	12.7
London, Ontario	808												
Southampton, Ontario	656	29.28	30.03	+.01	11.1	−8.8	19.1	3.1	45	−14	4.11	+1.21	40.8
Parry Sound, Ontario	688												
Port Arthur, Ontario	644												
Winnipeg, Manitoba	760												
Minnedosa, Manitoba	1,690												
Le Pas, Manitoba	860				−18.4		−8.6	−28.4	16	−54	.01		.1
Qu'Appelle, Sask.	2,115	27.74	30.19	+.11	−16.5	−15.9	−7.3	−25.7	31	−44	.91	+.18	9.1
Moose Jaw, Saskatchewan	1,759												
Swift Current, Saskatchewan	2,392	27.49	30.26	+.19	−15.8	−23.8	−6.1	−25.4	39	−54	.62	−.12	6.2
Medicine Hat, Alberta	2,365												
Calgary, Alberta	3,540	26.26	30.28	+.29	−12.0	−25.5	−2.7	−21.4	49	−36	.26	−.37	2.6
Banff, Alberta	4,521												
Prince Albert, Saskatchewan	1,450	28.60	30.33	+.24	−17.0	−14.0	−5.9	−28.2	21	−52	.31	−.38	3.1
Battleford, Saskatchewan	1,592	28.41	30.33	+.24	−21.4	−21.5	−8.7	−34.0	35	−56	.36	−.01	3.6
Edmonton, Alberta	2,150												
Kamloops, British Columbia	1,262												
Victoria, British Columbia	230												
Barkerville, British Columbia	4,180												
Estevan Point, British Columbia	20												
Prince Rupert, British Columbia	170												
Hamilton, Bermuda	151												
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Cape Race, Newfoundland	99				27.7		33.3	22.1	40	1	5.13		7.9
Sydney, Cape Breton Island	48	29.65	29.70	−0.23	27.2	+6.7	33.4	21.0	48	5	6.77	+1.67	26.7
Halifax, Nova Scotia	88	29.52	29.63	−.34	25.8	+4.0	31.7	20.0	49	3	8.55	+2.78	25.5
Yarmouth, Nova Scotia	65	29.70	29.77	−.23	28.4	+2.1	34.2	22.6	49	8	5.86	+.70	24.2
Charlottetown, Price Edward Island	38	29.68	29.72	−.24	21.6	+4.6	28.1	15.2	45	−5	5.81	+1.85	44.5
Chatham, New Brunswick	28	29.67	29.70	−.27	15.7	+5.9	25.1	6.4	41	−18	3.71	+.12	22.5
Father Point, Quebec	20	29.81	29.84	−.14	14.0	+6.0	20.6	7.5	33	−10	2.87	+.02	28.7
Quebec, Quebec	296	29.59	29.93	−.09	11.8	+2.7	17.9	5.8	34	−10	5.77	+1.76	57.7
Doucet, Quebec	1,236				−2.4		8.3	−13.0	30	−46	4.01		40.1
Ottawa, Ontario	236	29.70	29.98	−.05	9.4	−.2	17.1	1.7	38	−22	2.28	−.71	21.0
Cochrane, Ontario	930				−3.2		4.9	−11.3	34	−33	2.38		23.8
White River, Ontario	1,244	28.62	30.02	+.01	−3.8	−3.4	9.8	−17.4	31	−43	1.50	−.19	15.0
Southampton, Ontario	656		29.97	−.06	19.3	−1.1	24.8	13.8	40	−6	3.62		36.2
Parry Sound, Ontario	688	29.23	29.97	−.04	14.0	+.2	21.5	6.5	36	−25	2.93	−1.15	27.3
Port Arthur, Ontario	644	29.32	30.08	+.01	1.2	−1.9	10.9	−8.4	33	−29	.72		7.2
Winnipeg, Manitoba	760	29.28	30.20	+.09	−13.2	−6.4	−3.1	−23.2	21	−43	1.07	+.19	10.7
Minnedosa, Manitoba	1,690	28.20	30.17	+.07	−12.3	−5.1	−2.5	−22.2	18	−44	.65	−.15	6.5
Qu'Appelle, Saskatchewan	2,115	27.68	30.11	+.03	−8.6	−4.8	.0	−17.2	27	−32	1.00		10.0
Swift Current, Saskatchewan	2,392	27.39	30.08	−.01	1.7	−1.4	9.6	−6.1	33	−30	1.37	+.73	13.7
Calgary, Alberta	3,540	26.20	30.08	+.05	8.7	+.3	18.2	−0.7	46	−22	.65	+.12	6.5
Prince Albert, Saskatchewan	1,450	28.54	30.25	+.16	−11.8	−3.4	−3.1	−20.6	18	−43	1.01	+.04	10.1
Battleford, Saskatchewan	1,592	28.31	30.20	+.12	−11.0	−5.1	−2.7	−19.4	14	−41	.47		4.7
Edmonton, Alberta	2,150	27.69	30.15	+.12	−3.6	−5.4	4.2	−11.3	42	−29	1.78	+1.10	17.8
Kamloops, British Columbia	1,262	38.66	29.99	+.03	26.2	+3.2	31.2	21.1	41	4	1.73	+.91	17.3
Victoria, British Columbia	230	29.66	29.92	−.05	42.5	+4.0	45.7	39.2	50	32	5.25	−.14	.0
Estevan Point, British Columbia	20				41.6		46.4	36.7	50	29	13.30		.0
Prince Rupert, British Columbia	170				34.4		40.3	28.6	47	18	6.36		.2
Hamilton, Bermuda	151	29.94	30.11	−.02	62.9	+.9	67.4	58.5	78	47	3.74	−1.20	.0

TABLE 3.—*Severe local storms, February 1936*

[Compiled by Mary O. Souder from reports submitted by Weather Bureau officials]

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A revised list of tornadoes will appear in the Annual Report of the Chief of Bureau]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Kansas, eastern third of State	2-3					Glaze	Sleet or glaze in considerable quantities was reported over much of the eastern third of the State; travel hazardous.
Mississippi	2-4				$175,000	Excessive precipitation and flood.	Floods, extreme in the Pearl and Chickasawhay, but of only moderate height in the Leaf and Pascagoula, resulted from excessive precipitation; amount estimated for damage along streams.
Iowa	3					Snow and wind	9 inches of snow fell in some parts of the State; several passenger trains stalled in high drifts; State highway commission at Ames reported 16 main highways blocked; schools closed on following day; bus service in and out of Des Moines struggled under great handicaps with many schedules canceled on the 4th.
Grand Rapids, Mich	3-4					do	Heavy snow fell from 7 p. m. of the 3d to 2 a. m. of the 4th; visibility reduced to 440 yeards; automobiles and trucks stalled on highways which were impassable toward Muskegon and Grand Haven; railroad trains hours behind schedule, some canceled and several stalled in drifts 8 to 10 feet deep.
Meridian, Miss	3-4					Heavy rain and flood.	Heavy rainfall resulting in a flood; considerable property loss; suspension of business; bus and train service stopped; city gas main broken leaving many homes and industries without fuel for several hours.
Sheboygan City, Wis., and vicinity.	3-4					Snow	With the exception of the extreme northwestern part of Wisconsin, communities in this territory were isolated from the rest of the country today; few trains were running, motor travel for any distance was impossible, and airplanes were unable to land; several trains were stalled in snow drifts; all others were either held at division points or were running hours behind schedule; schools in numerous cities closed and many public functions were canceled.
Lincoln, Nebr	3-7	P. m.				Snow and wind	Strong winds during p. m. of the 3d swept 13 inches of snow on the ground into high drifts blocking both main and side roads; work of clearing began at once, but only main highways had been opened when one of the most severe storms of recent years struck on the evening of the 7th. Being forewarned few motorists were on the road; trains or buses were stopped or delayed; coal shortage threatened in many towns and no estimate can be given of hardships suffered by isolated farmers; clearing continued slowly, was not complete until late in the month.
Buffalo, N. Y., and vicinity	4			1	25,000	Severe gale, snow and ice.	Wind of 70 miles per hour at 3:07 p. m.; standing water froze on streets and sidewalks adding to the hazard of pedestrians and automobile traffic; 25 persons injured; many automobiles and trucks stalled and ditched; large chimney crashed through the roof of the chapel of St. Vincent Technical School; 2 freighters broke loose from their moorings in the harbor; plate windows blown in; power, trolley and telephone lines down; 2 fishing tugs sunk at Dunkirk.
Menominee City, Mich., and vicinity.	5					Snow	Drifts 6 feet high delayed trains, ferries and automobiles, while work of clearing channels and highways went on; all freight traffic disrupted.
Washington, D. C	6-7	11:55 p. m., 6th-4:45 p. m., 7th.				do	This was the heaviest 24-hour snowfall of record with the exception of the snowfall of Jan. 27-28, 1922.
Columbia, S. C	6-7					Glaze	Trees, shrubbery, wires and poles covered with ice; streets and sidewalks slippery.
Richmond, Va	6-7					Snow	Heaviest 24-hour fall recorded for this station during any February; traffic considerably slowed up; street cars and buses almost completely tied up from early morning to late evening of the 7th; drifts were from 3 to 4 feet high in places; stores, offices, and schools closed.
Havre, Mont	7					do	Flock of 2,000 sheep lost in snowstorm and the herder badly frozen.
West Virginia, southern section.	7					Heavy snow and wind.	Traffic demoralized on all highways because of drifting.
Norfolk, Va	7-8					Heavy snow	Street cars unable to operate; bus and automobile traffic greatly curtailed; schools closed; street very slippery.
Peoria, Ill., and vicinity	8	P. m.				Blizzard	Roads blocked; storm worse over the region from Galesburg to Monmouth, north-northeastward to Minnesota, Wisconsin, and Michigan.
Iowa, entire State	8			2		do	This storm worse than any that has hit this State in years. Sioux City first caught the full force of the storm; traffic paralyzed, street car and bus service canceled, and train service demoralized; veteran railroad men said it was the first time in their memory that all passenger train service in and out of Sioux City had been stopped. Council Bluffs, on the western borderline of the State, reported 3 inches of snow which the wind drifted into roads and over railroad tracks. Des Moines: Starting in the early morning, the storm raged throughout the day; all forms of transportation at standstill; at intervals visibility reduced to a few hundred feet; main highways and railroads not opened until the 11th; side roads remained blocked for indefinite period; fuel crisis prevailed due to the impossibility of delivering coal for several days after the storm; schools closed for 10 days; activities in churches greatly curtailed.
La Crosse, Wis	8					Snow	Rail traffic impeded to a great extent; many highways off the main roads were impassable the entire month.
Grand Rapids, Mich	8-9					Snow and wind	Heavy snow fell on the evening of the 8th, whirled in drifts by strong southwest winds, reduced visibility to from 440 to 880 yards; automobiles and trucks stalled; trains many hours late; drifts 8 to 10 feet high reported on highways and side roads outside of city in every direction; buses to Detroit and Chicago canceled; snow train to Petoskey canceled.
South Dakota	8-9			3		Blizzard	A blinding blizzard, in some sections the worst since 1888, swept over the State, leaving in its wake 3 dead, much human suffering, transportation systems paralyzed, and many towns isolated, with food and fuel shortage.
Wisconsin and Upper Michigan.	8-10			1		do	Traffic paralyzed; trains delayed for several days; snowfall measured from about 2 inches in Milwaukee, Wis., to 8 inches in Calumet and Hancock, Mich.; a criterion of the storm's viciousness was the fact that 1 fatality was a farmer who froze to death as he fought to get through the drifts in his own farm lane near Madison, Wis., while his son, 12 years old, trudged ahead.
Sacramento, Calif	11-12					Heavy rain	Greatest 24-hour rainfall in February since 1878.
Portland, Oreg	11-12					Glaze	Traffic impeded to some extent in downtown areas.

TABLE 3.—*Severe local storms, February 1936*—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Montana, entire State	11-13					Blizzard	Livestock losses over the State heavy, as drifting snow made it impossible to get feed to stock in some localities; highways impassable in most sections; airplane service paralyzed, with visibility rated as zero and landing fields drifted so that planes could neither land nor take off; storm played havoc with all forms of transportation service; in Missoula, Mont., snowfall 28 inches, largest amount in 24 hours for February; main highways closed; snow plows fought great drifts between Florence and Victor; all traffic delayed; schools closed. Eklaka, Mont., a small town in southeastern Montana, marooned; drifts 8 to 10 feet high blocked the road from Baker, 40 miles, and prevented the transportation of foodstuffs to the stranded town.
Los Angeles and San Francisco, Calif.	13				100,000	Rain, wind, electrical.	Torrential rains and roaring winds, accompanied by thunder and lightning, lashed the Pacific coast, tying up traffic, injuring several persons, and causing thousands of dollars' property damage; trees uprooted and roofs blown off along the southern California coast; thousands of persons left their suburban residences as near-flood waters poured down denuded canyons, cutting a path 3 miles wide through Long Beach and Torrance; a sudden freak twister blew down 6 huge oil derricks and injured 6 persons, 1 derrick catching fire; plane, auto, and rail traffic delayed and at some points halted in southern California; in Long Beach, where the vicious twister was followed by a torrential downpour, men stood by in boats to take people out of their homes; meanwhile, new storms were approaching the northern Pacific coast as San Francisco shook under its worst storm in 12 years; 10,000 school children confined to their homes as the storm brought an epidemic of cold, and officials ordered schools in many outlying cities closed; hail was recorded in northern California storm; property damage of many thousands of dollars; in southern portion of the State, damage was estimated to be over $100,000.
Wisconsin, southeastern portion.	13			1		Wind and snow	Racine and Kenosha Counties, which normally carry the highway traffic between Milwaukee and Chicago, almost completely closed; 1 death indirectly attributed to the storm in Milwaukee when a man collapsed while shoveling snow in front of his home.
Grand Rapids, Mich	13-14					Snow and mist	Heavy snow from 5:35 to 8 p. m., and light freezing mist from 10:30 p. m. to past midnight of the 13th-14th; driving hazardous because of ice on windshields; automobiles and trucks stalled in snow drifts; highways blocked; intercity bus schedules canceled; many trains hours late.
Harrisburg, Pa., and vicinity	13-14					Snow and sleet	Heavy snow and sleet fell during this storm; street car, bus, and automobile traffic suspended; 2½ inches of sleet caused damage to roofs of garages and sheds.
Henry County, Ala., northern portion.	14	3-4 p. m.	300	0	3,000	Tornado	1 person injured; property damaged.
Sandy Hook, N. J.	14					Ice	This was one of the most severe ice storms ever experienced in this section; ice from one-half to about an inch formed on exposed surfaces, wires, etc.; electric and telephone service seriously hampered; no electricity on Sandy Hook from 1:30 a. m. to 1:30 p. m.; ice forming on cups of anemometer to thickness of ¼ inch, interfered with wind-velocity records.
Wisconsin, entire State	14					Blizzard	In Manitowoc County all road crews called off waiting for wind to subside; visibility in Ozankee and lake shore counties reduced to nearly zero; roads blocked; trains delayed.
Richmond, Va.	15				60,000	Flood	This damage the result of the James River flood of the 15th.
Dallas, Tex.	17	A. m.				Glaze	Light rain froze on streets, windshields and other objects causing many accidents to pedestrians and motorists.
Minneapolis, Minn., southern portion.	17					Snow	Minneapolis-Omaha trains canceled by the Great Western R. R. and all freight trains south of Albert Lea and west of Minneapolis canceled by the Minneapolis & St. Louis R. R.; from 3 to 6 inches of newly fallen snow piled into drifts which forced abandonment of plowing by the State highway department in the Marshall area; drifting and high winds in the Alexandria district; several persons frozen to death.
South Dakota	17					Blizzard	Northeast wind whipped the snow-covered prairies of the State all day of the 17th and again blocked recently opened highways; rail traffic disrupted by noon and all highways closed to traffic by evening; subzero temperatures accompanying this storm hindered relief expeditions.
Rochester, N. Y., and vicinity	18					Wind and snow	Hundreds of motorists and at least 300 students marooned in zero weather as howling wind piled up huge snowdrifts on suburban highways in the Rochester area; all bus and automobile traffic halted; local trains running hours behind schedule; 150 students accommodated in homes of the village and in the school gymnasium.
Buffalo, N. Y.	18-19			2		do	Roads near North Collins, Chaffee, and Holland blocked by drifting snow; death of 2 persons due to exposure; automobile traffic, train service, etc., slowed down by cold, wind, and drifting snow.
Binghamton, Johnson City, and Endicott, N. Y.	19	A. m.				Sleet, snow, and rain.	Accompanying wind piled drifts high in the open rural stretches, blocking roads and driveways; streets slippery; high snowdrifts in Binghamton requiring 6 plows and many men to open highways; trains and bus service disrupted.
Snoqualmie Pass, near, Wash.	22	do		2		Rain and snow	Heavy rain fell on the deep snow adding much weight to the upper layers; many snowslides resulted; 1, on the 22d, occurred in the early morning on the Sunset Highway, near Snoqualmie Pass, when a number of vehicles were buried in the snow and 2 men smothered while others were extricated; all, in 1 bus containing 23 persons, rescued.
Colorado, southeastern portion.	23					Wind and dust	High winds carried the already loose topsoil of thousands of farms and ranches over most of eastern Colorado far into the air, reducing visibility and causing hazardous driving and flying conditions; black, swirling clouds of dust rolled over practically every county south of the fortieth parallel and east of the one hundred and fifth meridian; visibility reduced to practically nothing in many localities completely halting motor traffic; pedestrians collided with one another in attempting to get about during the height of the storm; Pueblo experienced the worst storm since the St. Patrick's Day black blizzard of 13 years ago; homes were filled with fine silt; several plate-glass windows were broken, fences blown over, and trees broken; visibility became negligible; all motor traffic stopped, and the city left with a coating of dust and sand thicker than any previously observed; by midafternoon the severity of the storm was reduced sufficiently to permit the resumption of travel on the highways; in many places dust lay from a few inches to more than a foot deep.

TABLE 3.—*Severe local storms, February 1936*—Continued

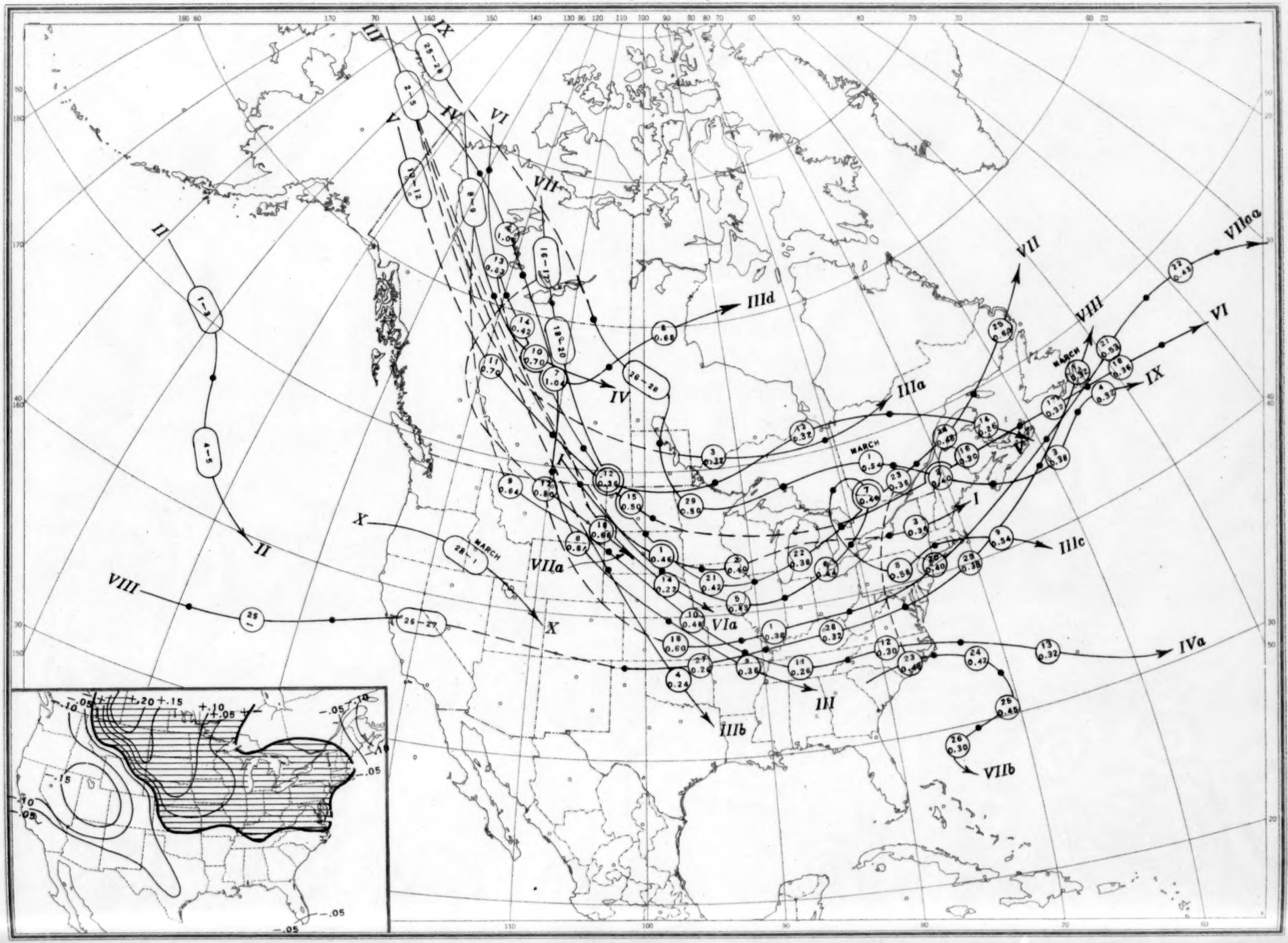
Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Watertown and northern New York.	24	4 p. m.				Dust and rain	The dust storm came upon the city rather suddenly; it grew dark and then a reddish cast was noticeable; in Canton where windows were covered with fine particles of gray matter, motorists who left their cars parked and then returned to them shortly after 4 p. m., were greatly surprised to find the top of the hoods, windows, and fenders covered with a fine coating of dust; housewives were disconcerted to see such a layer of dust spread out upon clear window panes; there is no question but that this dust came from southeastern Colorado and western Kansas.
Truckee, Nev., and Lake Tahoe, Calif., and vicinity.	24			7	$1,000,000	Flood and blizzard.	This blizzard raging in the Sierra Nevada Mountains, blocked the Donner Summit Highway and 750 motorists were stalled; after being released, many automobiles had been partially buried in drifts, these cars were taken over ice-covered highways in convoys; Sacramento Valley flooded.
Oklahoma City and Wheatland, Okla., and vicinity.	25	11–12 p. m.			1,000	Hail	Fall of hail unusually heavy for this season; damage to greenhouses and buildings.
Carthage, Brighton, Mo., and vicinity.	26	3 a. m.	100-300	0	15,000	Tornado	Damage of $2,000, 16 miles east of Carthage when 2 tourists' cabins were demolished and falling trees destroyed a filling station; at Brighton, a residence, 7 barns, and numerous outbuildings were destroyed; from Brighton the storm followed a well-defined path toward the northeast, wrecking about 20 outbuildings and sheds; path 50 miles long.
Turley, Okla.	26	1:15 a. m.	100	0	15,000	Tornado and heavy rain.	18 persons injured; damage principally to buildings; path 5 miles long.
Minneapolis and southern Minnesota.	26					Wind and snow.	Communities from the southwestern corner of the State reported from 1 to 20 feet of snow in drifts; highway travel impossible; train and bus service suspended in Windom and Fairmont; near Austin, abandoned cars dotted the highways for miles, about 200 motorists being marooned.
South Dakota, eastern half of State.	26					Blizzard	Highways blocked; traffic canceled.
Sioux City, Iowa, and vicinity.	26-27					Wind and snow.	Service on Illinois Central canceled; 23 passengers stranded on a stalled train at Marcus; all available men at Marcus and Cherokee employed in digging out a snow drift 15 feet deep that blocked rail traffic 2 miles west.
Minnesota, southern and southwestern portions.	27					do	One of the heaviest snowstorms in years; in the southwestern corner of the State from 12 to 20 inches of snow was reported; highway travel impossible; plows were held at road stations until wind subsided.
Buffalo, N. Y., and vicinity	27				750	Wind	A 57-mile gale caused the injury of 1 person; property damaged.
Grand Forks, N. Dak.	27					Wind and snow.	Heavy snows fell over all North Dakota except in the extreme western portion of the State; the highway department reported practically all roads blocked except in the Dickinson and Williston divisions; all railroad service north and west of city stopped; 25 persons on the Northern Pacific Twin City-Winnipeg train marooned over night; the westbound Great Northern Empire Builder rerouted to escape the Grand Forks area.
LATE REPORT JANUARY 1936							
Painter Village, Va.	19	A. m.	300		$4,000	Straight line wind.	Damage limited mostly to small buildings and telephone poles.
Grafton, Va., vicinity of.	19	1:30-2 p. m.	50		10,000	Wind	Damage to small buildings.

Chart I. Departure (°F.) of the Mean Temperature from the Normal, February 1936

Shaded portions show excess (+)
Unshaded portions show deficiency (−)
Lines show amount of excess or deficiency
Statute Miles
Kilometers

Chart II. Tracks of Centers of Anticyclones, February 1936. (Inset) **Departure of Monthly Mean Pressure from Normal**

(Plotted by W. P. Day)



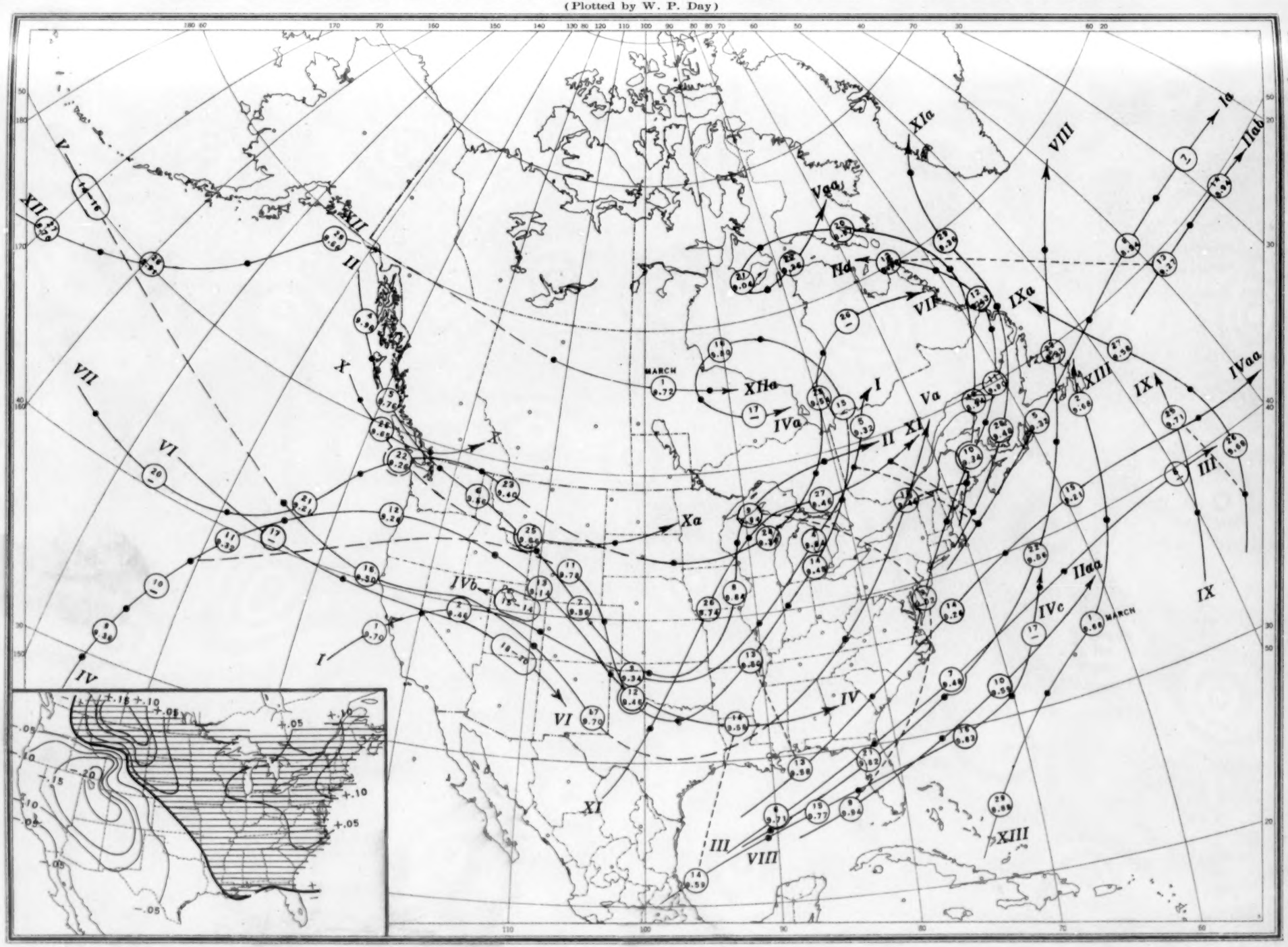
Circle indicates position of anticyclone at 8 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 8 p. m. (75th meridian time).

Chart III. Tracks of Centers of Cyclones, February 1936. (Inset) **Change in Mean Pressure from Preceding Month**

Circle indicates position of anticyclone at 8 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 8 p. m. (75th meridian time).

Chart III. Tracks of Centers of Cyclones, February 1936. (Inset) **Change in Mean Pressure from Preceding Month**

(Plotted by W. P. Day)



Circle indicates position of cyclone at 8 a. m. (75th meridian time), with barometric reading. Dot indicates position of cyclone at 8 p. m. (75th meridian time).

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, February 1936

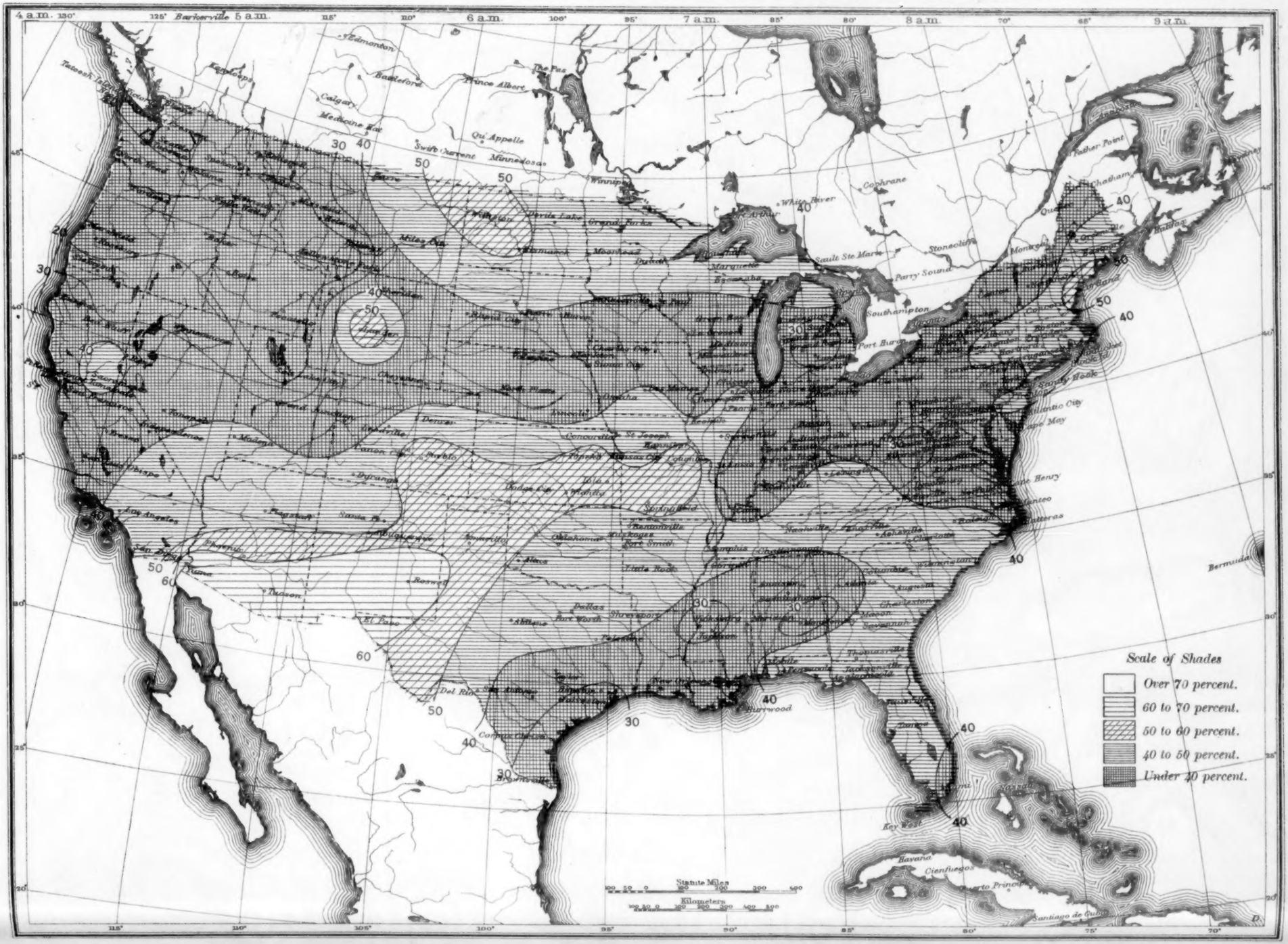


Chart V. Total Precipitation, Inches, February 1936. (Inset) Departure of Precipitation from Normal

Chart V. Total Precipitation, Inches, February 1936. (Inset) **Departure of Precipitation from Normal**

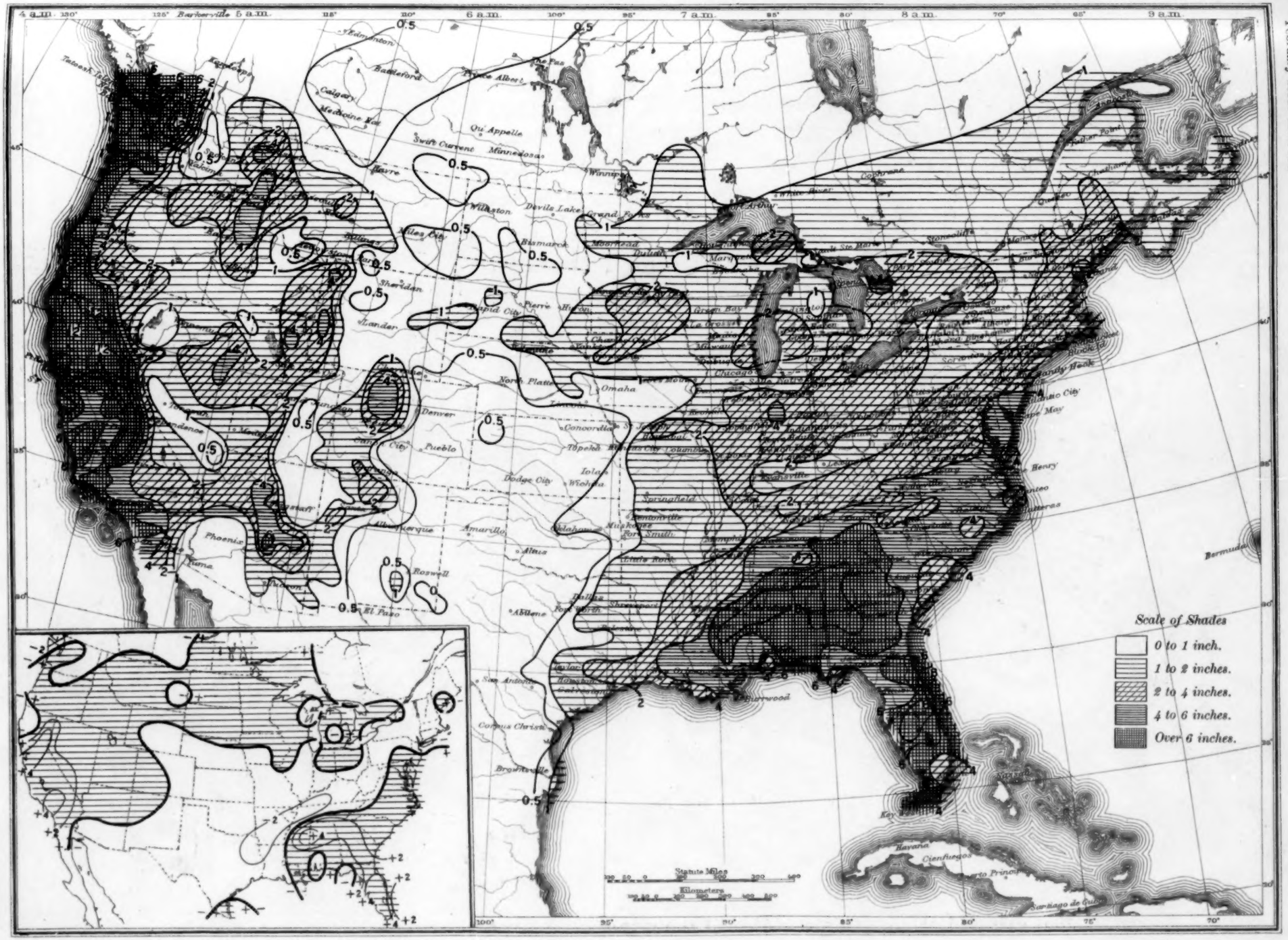


Chart VI. Isobars at Sea Level and Isotherms at Surface; Prevailing Winds, February 1936

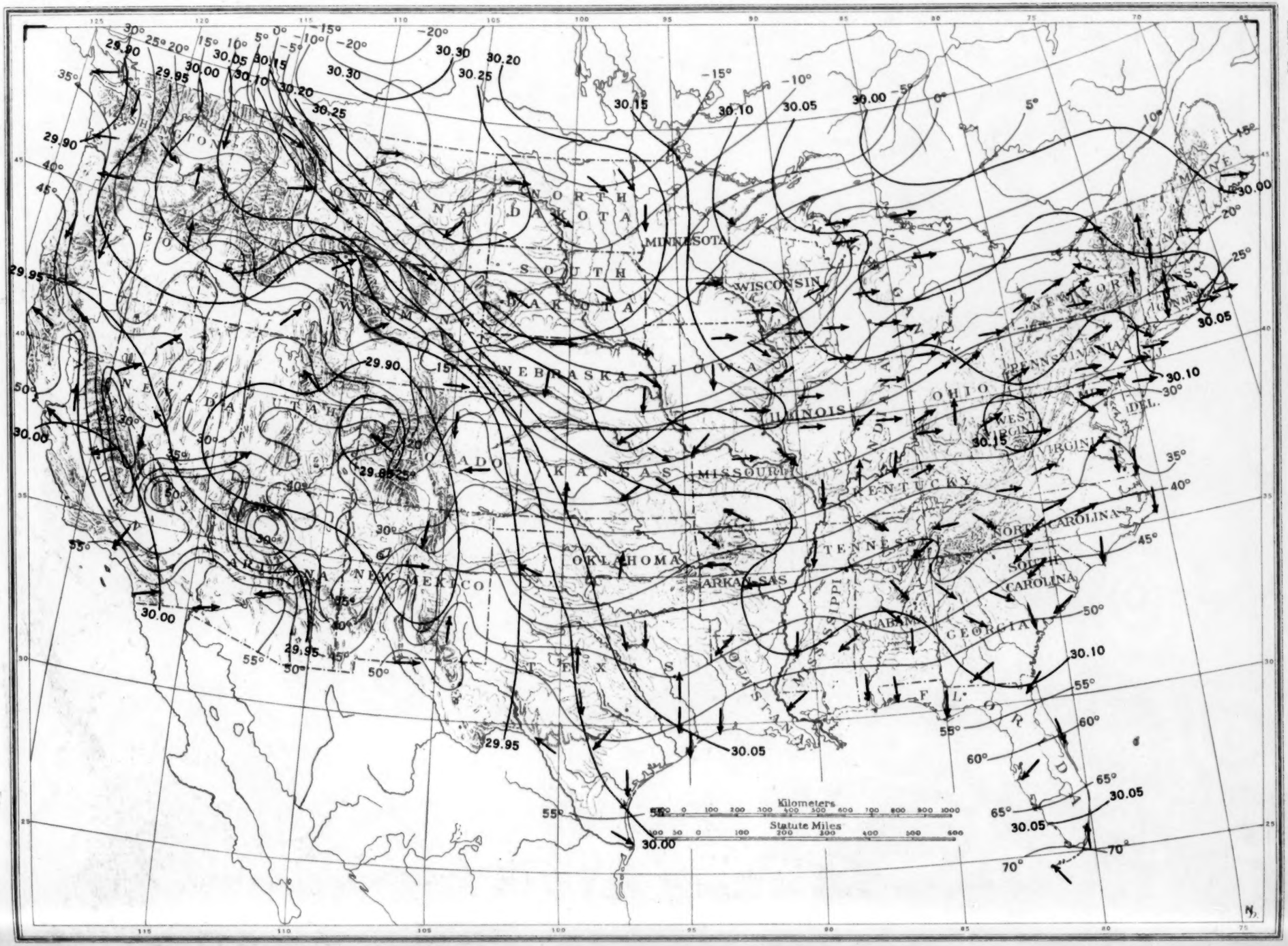


Chart VII. Wind Roses for Selected Stations, February 1936

Chart VII. Wind Roses for Selected Stations, February 1936

(Plotted by W. W. Reed)

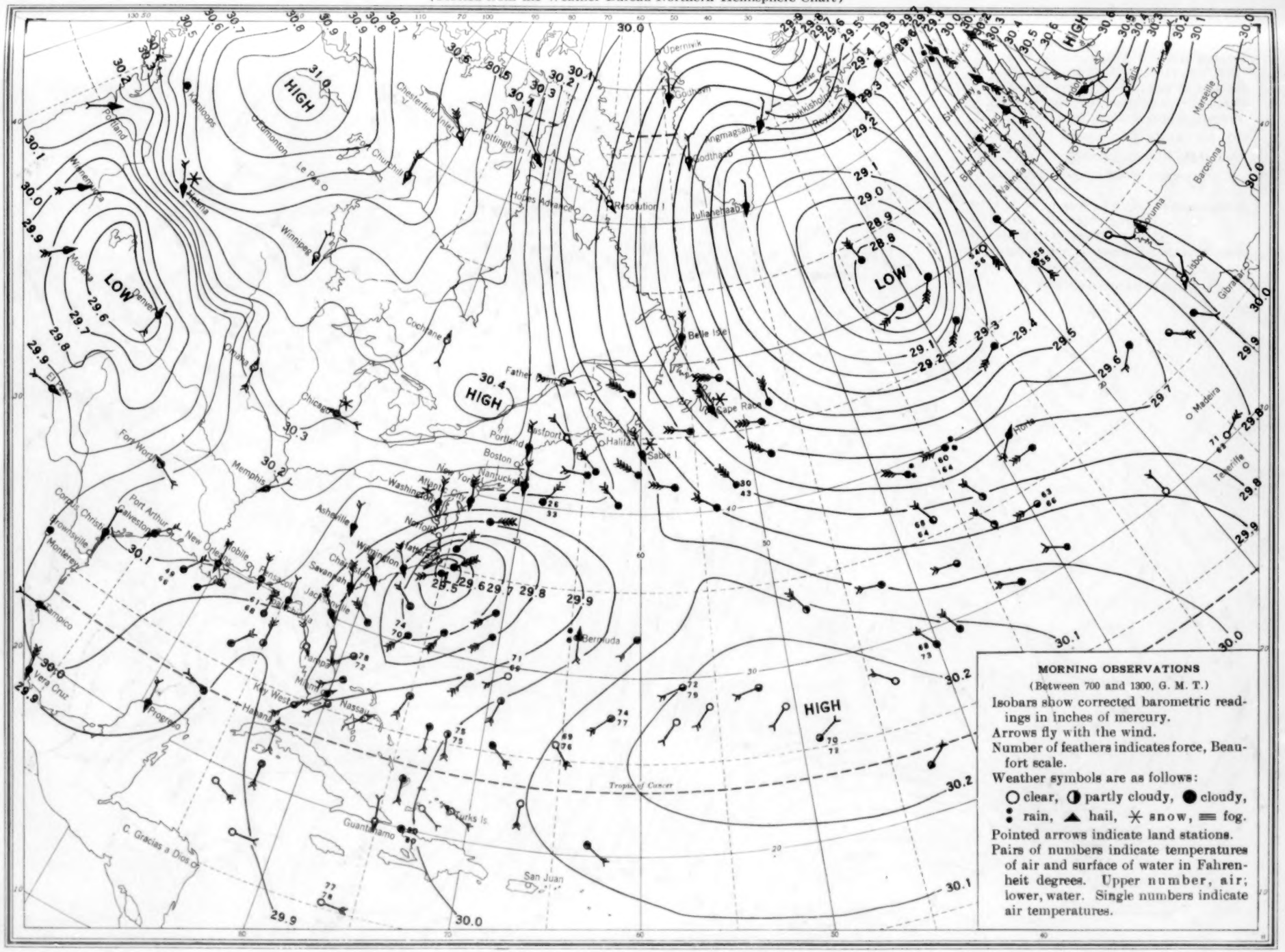
Chart VIII. Total Snowfall, Inches, February 1936. (Inset) Depth of Snow on Ground at 8 p. m., Monday, March 2, 1936

Chart IX. Weather Map of North Atlantic Ocean, February 7, 1936

(Plotted from the Weather Bureau Northern Hemisphere Chart.)

Chart IX. Weather Map of North Atlantic Ocean, February 7, 1936

(Plotted from the Weather Bureau Northern Hemisphere Chart)


HIGH
LOW
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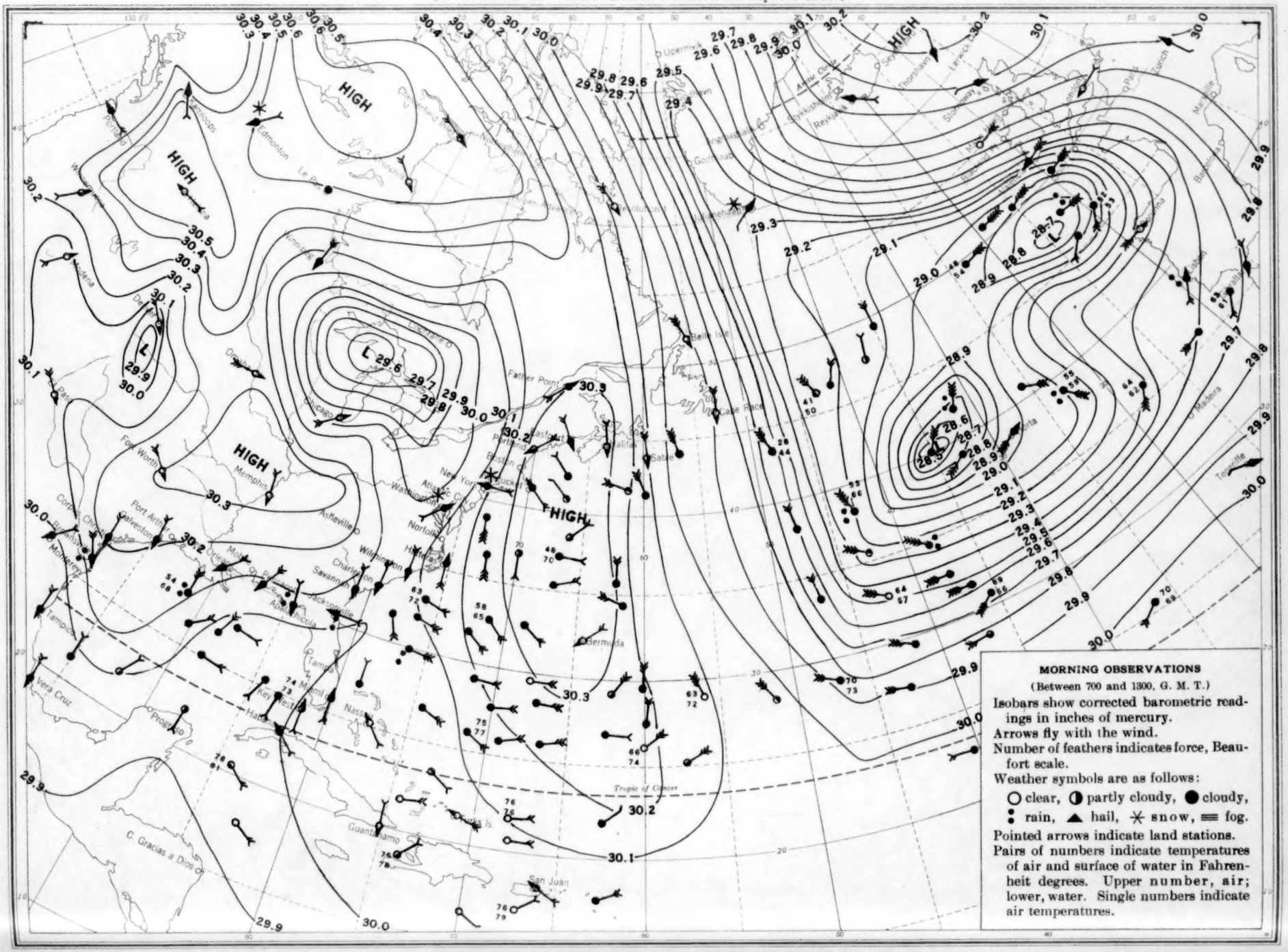
LOW
HIGH
Tropic of Cancer
Portland
Kamloops
Edmonton
Chesterfield Inlet
Churchill
Nottingham I.
Upernivik
Godthaab
Julianehaab
Resolution I.
Belle Isle
Cape Race
Sable I.
Halifax
Bermuda
Marseille
Barcelona
Lisbon
Gibraltar
Madeira
Teneriffe
Winnipeg
Cochrane
Chicago
Portland
Boston
Nantucket
New York
Washington
Norfolk
Memphis
Ashville
Wilmington
Charleston
Savannah
Jacksonville
Miami
Key West
Nassau
Havana
Mobile
New Orleans
Port Arthur
Galveston
Corpus Christi
Brownsville
Monterey
Tampico
Vera Cruz
Progreso
Guantanamo
Turks Is.
San Juan
C. Gracias a Dios
Denver
El Paso
Fort Worth
Belle Isle
Cape Race
Sable I.
Bermuda
Nassau
Havana
Key West
Miami
Jacksonville
Savannah
Charleston
Wilmington
Norfolk
Washington
New York
Atlantic City
Nantucket
Boston
Portland
Eastport
Halifax
Sable I.
Cape Race
Belle Isle

Chart X. Weather Map of North Atlantic Ocean, February 9, 1936

(Plotted from the Weather Bureau Northern Hemisphere Chart)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MORNING OBSERVATIONS
(Between 700 and 1300, G. M. T.)
Isobars show corrected barometric readings in inches of mercury.
Arrows fly with the wind.
Number of feathers indicates force, Beaufort scale.
Weather symbols are as follows:
○ clear, ◑ partly cloudy, ● cloudy,
• rain, ▲ hail, ✳ snow, ≡ fog.
Pointed arrows indicate land stations.
Pairs of numbers indicate temperatures of air and surface of water in Fahrenheit degrees. Upper number, air; lower, water. Single numbers indicate air temperatures.

Chart XI. Weather Map of North Atlantic Ocean, February 10, 1936

(Plotted from the Weather Bureau Northern Hemisphere Chart)

Chart XI. Weather Map of North Atlantic Ocean, February 10, 1936

(Plotted from the Weather Bureau Northern Hemisphere Chart)

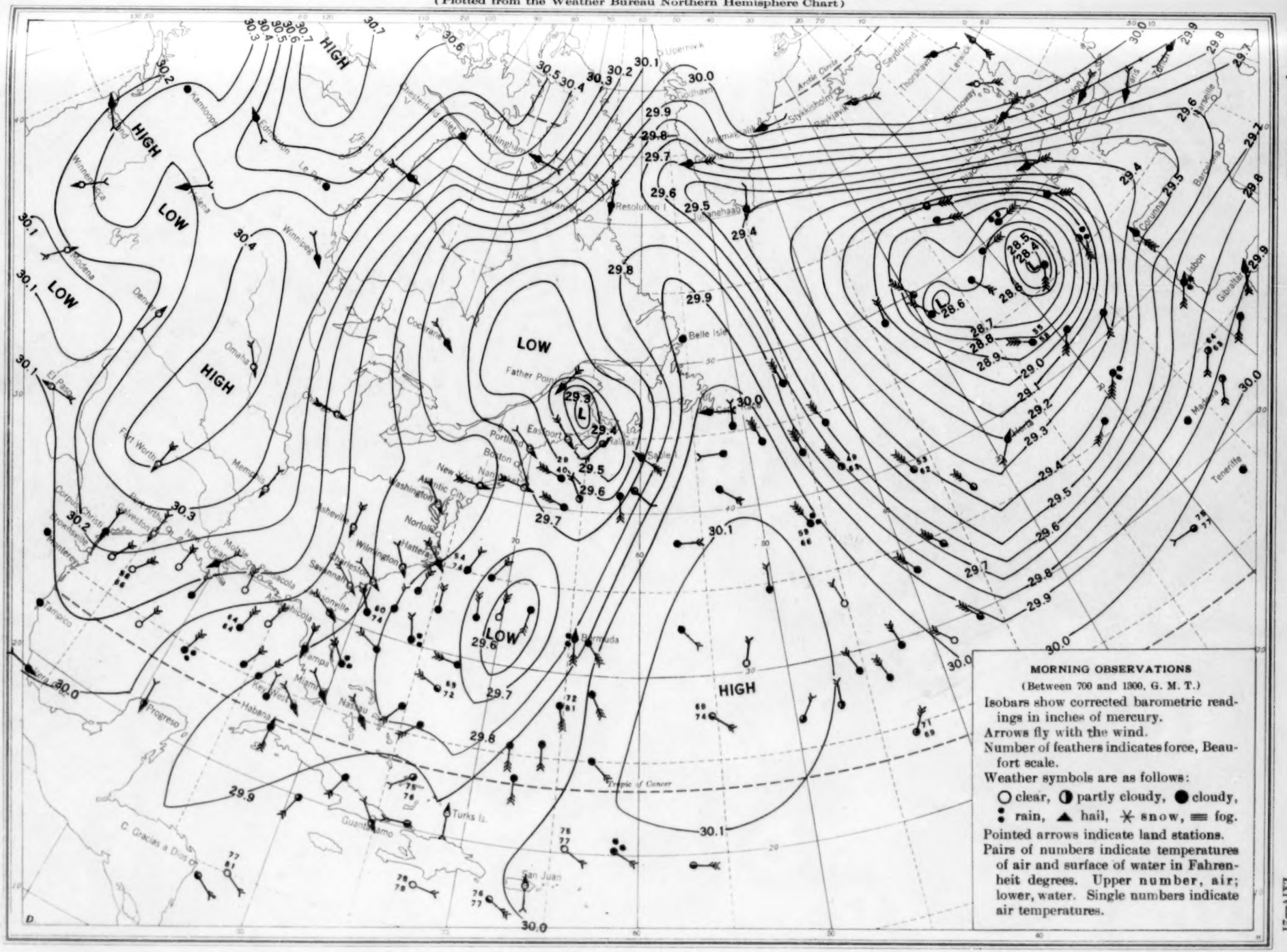
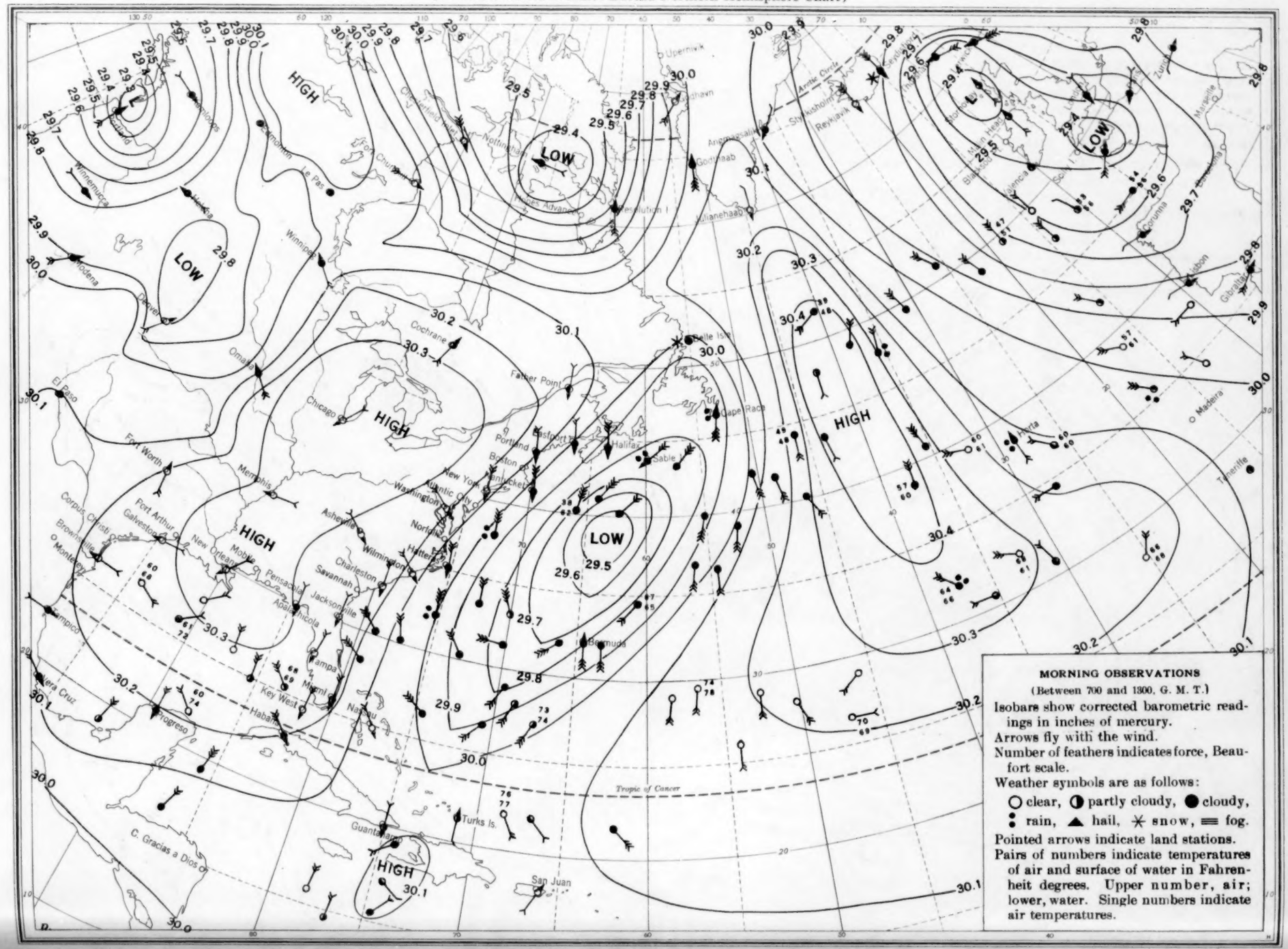

HIGH
LOW
HIGH
LOW
LOW
HIGH
LOW
HIGH
Kamloops
Edmonton
Winnipeg
Medicine Hat
Calgary
Prince Albert
Prince Rupert
Victoria
Seattle
Portland
Spokane
Helena
Billings
Minneapolis
Duluth
Sault Ste. Marie
Toronto
Buffalo
Rochester
Albany
Boston
Portland
Eastport
Halifax
Sydney
Belle Isle
Father Point
Cochrane
Resolution I.
Upernivik
Godhavn
Angmagssalik
Julianehaab
Stykkishólmur
Reykjavik
Seydisfjord
Thorshavn
Lerwick
Stornoway
Aberdeen
Valentia
Roches Point
Barcelona
Coruña
Lisbon
Gibraltar
Madeira
Tenerife
Marseille
Nice
Rome
Malta
Chicago
Detroit
Cleveland
Pittsburgh
Buffalo
Omaha
Denver
El Paso
Fort Worth
Memphis
Nashville
Cincinnati
Washington
Atlantic City
Norfolk
Hatteras
Wilmington
Charleston
Savannah
Jacksonville
Pensacola
New Orleans
Galveston
Corpus Christi
Brownsville
Monterey
Tampico
Progreso
Habana
Key West
Miami
Tampa
Nassau
Bermuda
Turks Is.
Guantanamo
San Juan
C. Gracias a Dios
Tropic of Cancer
30.3 30.4 30.5 30.6 30.7 HIGH 30.7 30.6 30.5 30.4 30.3 30.2 30.1 30.0
29.9 29.8 29.7 29.6 29.5 29.4 29.3 L 29.4 29.5 29.6 29.7 29.8 29.9 30.0
30.2 30.1 30.0 29.9 29.8 29.7 29.6 29.5 29.4 29.3 29.2 29.1 29.0 28.9 28.8 28.7 28.6 28.5 28.4 28.5 28.6 29.0 29.1 29.2 29.3 29.4 29.5 29.6 29.7 29.8 29.9 30.0
30.1 30.4 30.3 30.2 30.1 30.0 29.9 29.8 29.7 29.6 29.5 29.4 29.4 29.5 29.6 29.7 29.8 29.9 30.0
30.1 30.4 30.3 30.2 30.1 30.0 29.9 29.8 29.7 29.6 29.7 29.8 29.9 30.0
30.1 30.3 30.2 30.1 30.0 29.9 29.8 29.7 29.6 29.7 29.8 29.9 30.0
30.2 30.1 30.0 29.9 29.8 29.7 29.6 29.7 29.8 29.9 30.0

Chart XII. Weather Map of North Atlantic Ocean, February 22, 1936

(Plotted from the Weather Bureau Northern Hemisphere Chart)


HIGH
LOW
Tropic of Cancer
Arctic Circle
MORNING OBSERVATIONS
(Between 700 and 1300, G. M. T.)
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